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MUD-LOVING FISHES.

BY CHARLES C. ABBOTT, M.D.

Fig. 86.

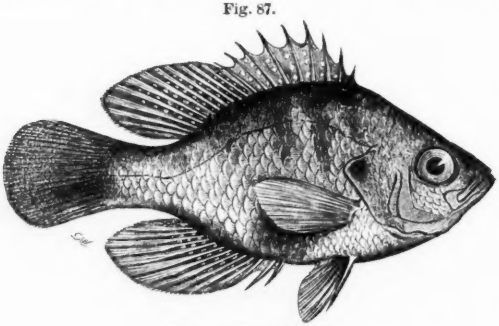
Melanura limi.

Much is lost to those who essay to study the habits of fresh-water fishes, first, by ignoring uninviting mud-holes, and secondly, by walking carelessly to the banks of the stream, and seeing nothing at first, think they are themselves unseen by anything inhabiting the water. Never was there a greater mistake! Nine times in ten, if these same streams be approached cautiously, and yourself concealed, you peer carefully into the water, you will find it tenanted by many and larger fishes, than you supposed were there. Following out this plan, we once saw and captured a chub (*Semotilus rhotheus*) thirteen inches long, in a narrow brook of but six inches in depth. This fish, when the bank was carelessly approached, would withdraw to a deserted muskrat burrow.

After standing quietly for a few minutes upon the bank of a stream that has been openly approached, one will notice

the gradual appearance of the fishes your sudden presence startled and sent off; but returning under such circumstances they are not the same fish in their movements; for although *they may appear to swim about fearlessly*, they nevertheless are watching you, and fail to exhibit many of their peculiar habits. An aquarium, even, in which fishes become tame, is best watched at a distance, as more is going on generally, than when you are near by. Fish are like children, fuller of mischief when alone. These remarks, be it understood, apply to some species—not all. What we design considering as mud-loving species are nine in number, all common to the Delaware and its tributaries, at and near Trenton,

Fig. 87.



Enneacanthus guttatus.

New Jersey. They are the Spotted Sun-fish (*Enneacanthus guttatus*,* the Mud Sun-fish (*Acantharcus pomotis*), the Mud Minnow (*Melanura limi*), Mud Pike (*Esox porosus*), Mullet (*Moxostoma oblongum*), Black Sucker, *Catostomus* (*Hylomyzon*) *nigricans*, Mud Cat-fish (*Amiurus DeKayi*), Eel (*Anguilla tenuirostris*), and the Lamprey (*Petromyzon nigricans*). (We consider the *Ichthyomyzon appendix* as the young of the last, or an allied *Petromyzon*).

Spotted Sun-fish (*Enneacanthus guttatus*). We have very

* We trust the nomenclature of our fishes is finally established; and no species will be farther burdened with confusing synonomy. We follow Cope (Journal Acad. Nat. Sci., Phil., Vol. vi, part 3, p. 216, Jan., 1869), in this paper; and if farther changes are proposed, feel now as though we should adopt them with reluctance.

carefully searched for a trait characteristic of this fish as compared with *E. obesus*, and have uniformly failed to do so. The habits of the species are those of the Centrarchidæ generally, modified in so far as being merely more of a mud-loving species. So purely a mud-dwelling fish are they that we have frequently found them in water so shallow, that they marked the mud with their pectoral fins in swimming; preferring such shallow water, with the mud, to that which was deeper, to which they had access, because it was over a stony bed. In winter they congregate in deep water, and unless care is taken to dig well into the mud they will not be taken in the ordinary scoop-net. We found, during the past winter, in one instance, that a large number had *apparently* scooped out a basin in the bottom of a little pond. At any rate, closely huddled together, in a small space, somewhat deeper than the surrounding bed of the pond, was a large number. Examination of several showed they were then taking no food. The stomach of each specimen, and the whole digestive tract, in fact, were empty.

The main interest attaching to this species, at least to us, is the fact of its occupying many small, sluggish streams, similar and side by side with others that harbor, though less abundantly, the *E. obesus*. We never yet have found them associated in small streams, in the tributaries of the river; yet, in the Delaware itself the *E. obesus* is occasionally, and the *guttatus* frequently found. North-east of Trenton, in the Spar-kill, a creek emptying into the Hudson, and in the streams along the coast, emptying into the bays, the *E. obesus* abounds; and the *guttatus* has not been found. Along the Delaware both are found, the *guttatus* more abundantly. Professor Cope has found *E. guttatus* near Richmond, Virginia, and (verbal communication) has not found it about Philadelphia. It is undoubtedly in the Delaware, at Trenton —distance thirty-seven miles. We have been thus particular in stating its habitat, because the fact of its not associating with the *E. obesus* is a mystery we cannot explain,

except in the manner following. The similiarity of these two Enneacanthi is so marked, that unless living, they can scarcely be distinguished; and considering the abundance of one and presence of the other, but not associated, we suggest that the *E. obesus* is with us, not of its own choice, but forcibly brought by freshets from the localities where it is the only Enneacanth (New York State) to this, the proper territory of the *E. guttatus*. Once here it occupies certain streams from which it has driven the former occupant, *E. guttatus*. It is always found in the streams having unobstructed access to the river. If this be a true explanation of its presence does it not confirm its claim to a distinct specific title? In the "Geology of New Jersey" we confounded the two species, considering *Pomotis guttatus* Morris, a synonym of *Bryttus obesus* Girard.

On the 16th of March we found females of the Mud Minnow (*Melanura limi*), in clear, cold, running water. They were much distended with large masses of orange-colored eggs, that we should judge were nearly "ripe." We have watched them frequently since but failed to find them depositing these ova. At this time, April 19, a large proportion of the females are no longer gravid. It would appear that in March they were passing up stream, or brook, to spawn, but appeared to be unaccompanied by males.

We have lately found that this fish, when grown, feeds largely upon small shells (*Physa* and *Lymnæa*). We have seen them seize the animal, crush and then drop the shell, and then, by nibbling at the extruded soft parts, finally succeed in devouring all but the shell. Young crawfish are also worried to death by this cyprinodont, which at first bites off the larger claws, and ultimately succeeds in crushing the whole shell. On the other hand they are themselves exposed to attacks from a voracious animal, which takes advantage of their lying buried in the mud. We refer to the odoriferous Cinosternoid (*Ozotheca odorata*). This turtle appears to be able to discover the whereabouts of the mud-

minnows without alarming them; and cautiously approaching from behind, they seize the head of the fish that is scarcely extruded from the mud. This they generally completely sever from the body, cast aside, and then draw from the mud the decapitated body. We doubt the ability of this turtle to catch a mud-minnow not concealed *in* the mud. When lying *on* the mud, like an Etheostomoid, their movements are very rapid when disturbed.

In speaking of the habits of certain species of fishes as 'mud-loving," or dwellers in and upon mud, we really indicate merely those species that are most truly nocturnal. We judge that, to a certain extent, all fish are nocturnal. We have often noticed that fish will leap from an aquarium, if uncovered during the night; but this occurs but seldom during the day. Fishing with a line has always been more fruitful with us at night than fishing during the day; even when fishing for yellow or white perch, and other active day fish. Nets set over night entrap a greater number, and larger specimens, than when set for the same number of hours between sunrise and sunset.

These remarks are peculiarly applicable to the two Catostomoids we have mentioned above, *Moxostoma oblongum* and *Hylomyzon nigricans*. Unless quite small, less than six inches in length, these "suckers" remain quiet throughout the day; but as night approaches they leave the shallow, muddier portions of the creeks, and swim towards and into the deeper. waters. About sunset we have often noticed them coming to the surface, and with their nostrils above the water, they make a low, sibilant sound, and leave in their wake a long line of minute bubbles. When attacked, as they frequently are at this time, by turtles, they give a very audible grunt, similar to that of our chub when drawn from the water. Both of these "suckers" are occasionally found, even during the day, in running water, hunting among the stones upon the bottom; but still water and soft mud are never far distant. The "suckers" of our rivers are very

different in *their* likes and dislikes. Coming up the stream in February and March, the large-scaled species, *Teretulus macrolepidotus*, and the common *Catostomus Bostoniensis*, seek out rapid waters, rocky bottoms, and are so active and fearless during the day, that many are seen and killed in the shallow waters they have entered. This is very noticeably the case at Trenton, New Jersey, where the Assunpink creek enters the Delaware. The "suckers" come up to the foot of the dam and congregate there in large numbers. Both of these species bite readily at a hook; but the "mullet" and "black-sucker" never do with us.

We can imagine nothing more devoid of interest than a mud-catfish (*Amiurus DeKayi*), at least as we have them here in New Jersey. Occasionally one of unusual size is met with to give it some characteristic worthy of attention. The largest specimen we have ever seen weighed five pounds, thirteen ounces. The greatest width of the head was five and one half inches. This species wallows in the mud in the beds of streams of all sizes; it is abundant in many of our largest creeks, in every mill-pond, and in average sized ditches with overhanging banks, this "mud-lover" frequently congregates in large numbers. It is a little curious to notice how soon matters right themselves, as to the distribution of fishes, after a freshet has subsided which had obliterated the previous boundaries. We have in mind now an extensive tract of meadow, through which meanders two rapid current creeks, and also through it are cut innumerable ditches. In these ditches dwell several mud-loving fish. Of course the freshet produces considerable of a "scatter" among them; but on the subsidence of the water we very seldom find mud cat-fish in the clear-water creeks, and the running water species caught napping in the ditches very promptly leave, as a few days suffice to restore to each locality its characteristic species.

In our report in the "Geology of New Jersey," we gave but three fresh-water siluroids. Since then we have had our

attention called to the stone cat-fish (*Noturus gyrinus*), from the Delaware Water Gap, Warren County, New Jersey. Besides the specimens from this locality in the Museum of the Philadelphia Academy we have seen one living specimen in an aquarium, taken in the Assunpink Creek at its mouth. This is the only living specimen taken in New Jersey that we have ever seen, but learn that it is common in some of the rocky creeks in the northern part of the State.

The Eel (*Anguilla tenuirostris*), as elsewhere we suppose, is abundant in all our water courses. A careful examination of specimens from various localities, and comparison of reports of local fishermen, tend to the fact (?) that the largest eels are to be found in the rivers and streams directly tributary to them; and that in isolated mill-ponds far distant from the main water courses, they are not so large or numerous. We do not admit that such is really the case, but it does *appear to be true*. The experience of other observers would be interesting to know; and how large do our various species of *Anguilla* grow, as found in fresh-water? In the Delaware and its many small tributaries we find the Lamprey (*Petromyzon nigricans*) very abundant. Although occasionally found sticking to the sides of large fish, shad, rock-fish, white-perch and chub, they do not appear to feed upon fish thus exclusively. We have frequently found a large quantity of them adhering to the carcasses of dogs and other drowned animals, and judge that they subsist upon dead, rather than living animal matter. In an aquarium they adhere to the glass sides and *remove* the green scum very effectually, but whether they devour it or not we could not ascertain. We have known the Lampreys to *suck* their way up the facing of mill dams and so wander far up from the river. In such cases they bury themselves in the mud, in the winter, as do eels instead of following the river out into the sea.

VARIATIONS IN NATURE.

BY THOMAS MEEHAN.

THE idea that art has made most of the variations we find in gardens is far removed from the truth. It has done much to prevent a true knowledge of the origin of species. Art has done little towards making variations; it has only helped to preserve the natural evolutions of form from being crowded out. There is scarcely any species of wild plants but will furnish numberless variations, if we only look for them. To-day I examined a large patch of ox-eye daisies (*Chrysanthemum leucanthemum*). The first impression is that they are remarkably uniform, yet there were some with petals as long only as the width of the disk; others with petals double the length. In some the petals taper to a narrow point; in others they are tridentate on the apex. Again, some flowers have petals uniformly linear. Others have them tapering at both ends. Some have recurved and others flat petals. In one plant the *scales of the involucre were very much reflexed*, a very striking difference from the usually closely appressed condition.

I have frequently found that these very common things which nobody looks at, furnish as many new facts to an enquiring mind, as the rare species which every one loves to see.

OBSERVATIONS ON THE FAUNA OF THE SOUTHERN ALLEGHANIES.

BY PROFESSOR E. D. COPE.

I. On the so-called Alleghanian Fauna in General. The terms Canadian and Alleghanian, have been applied by Pro-

fessors Verrill* and Agassiz† to faunal associations of species of animals, characteristic of Canada and adjacent territory, and the Middle and Eastern United States, etc. The former author, in the later essay quoted, attempts to define these faunæ in a more or less precise manner, regarding the southern boundary of the first as "coincident with a line which shall indicate a mean temperature of 50° Fahrenheit, and the southern boundary of the second, to be the line of 55°." In accordance with this view the southern boundary of the Canadian fauna, commencing at the mouth of the Penobscot River in Maine, extends parallel with the coast into New Brunswick, and returning through middle Maine passes south of Moosehead Lake and the White Mountains, along the eastern base of the Green Mountains to the south, and up their western foot to the river St. Lawrence. From near Montreal it turns to the south-west, and, passing through Lake Ontario, crosses Michigan from St. Clair to Milwaukee, and rises following the valley of the Mississippi northwards. The Adirondack Mountains were regarded as a portion of this fauna, surrounded, like an island, by the Alleghanian.

The southern boundary of the Alleghanian was traced from near Norfolk, Virginia, up the valley of the James River to the Alleghany Mountains, southward along their base to their termination in Georgia, and then north again along their western slope to Kentucky and the Ohio River. The Southern, or Louisianian, fauna included the lower portion of the Ohio basin, and an undetermined extent of that of the Mississippi north of the latter. The boundary line then descended to the south to the west of that river. I may suggest here that the most northern habitat of the *Siren lacertina* might prove to be near the northern extreme of the boundary in question. This point, so far as I am aware, is

* Proceedings Essex Institute, III. 136. Proceedings Boston Society of Natural History, 1866, 260.

† Nott and Gliddon, "Types of Mankind," 1853.

Alton, Illinois, from which place I have a specimen of that species.

My object at present is to show that the region, including the crest of the Alleghany Mountains to their southern extremity in Georgia, possesses a fauna in many respects entirely different from that of the southern two-thirds of the Alleghanian fauna as defined by Verrill, and in some respects as similar to the Canadian. My conclusions are based more on observations on the distribution of birds than on animals of other classes, as were also those of Professor Verrill. They are very imperfect, and I have no doubt that additional observations will increase the weight of evidence in the direction here pointed out.

Among Mammalia three species may be noticed, namely: *Sciurus Hudsonius*, *Cervus Canadensis*, *Lynx Canadensis*. The first named species is characteristically northern, and little known in the southern part of the above defined Alleghanian fauna. In southern and eastern Virginia it is unknown, as well as in North Carolina and Tennessee. It is, however, not uncommon on the summits and crests of the Alleghanies in both the former states. In North Carolina and southern Virginia it is so restricted to the heights as not even to descend into the mountain valleys. I resided for nearly two months at the Warm Springs, Madison county, North Carolina, and in Henderson county, in the same state, at an elevation of two thousand five hundred feet above the sea, without observing a single individual; yet the inhabitants are well acquainted with them as game of the mountain tops, under the name of the "Mountain Boomer," a name they bear in Virginia, also. This distribution and name are mentioned by Audubon and Bachman in their great work.

The elk is recorded by Baird as having left remains, during human habitation, in West Virginia. Of this fact I was also assured when in the same region. Dr. Hardy, of Asheville, North Carolina, states that horns of the elk were found in

the woods on the Black Mountains at that southern point, when he was younger, and that he is satisfied that its range extended nearly to South Carolina during the human period. This species formerly ranged over the Alleghanian fauna, but is now nearly confined to the Canadian.

Like the red squirrel the Canada lynx extends to the southern limits of the Alleghany ranges, occupying the highest ground, though apparently not so restricted to the elevations as the first named. It is distinguished, by the name catamount, from the *Lynx rufus* which is called wild cat, and is well known to the hunters. It is known to be a northern species, being unknown in the wilds of the lower country of Virginia and North Carolina, where the *L. rufus* takes its place. What its southern limit is, in eastern and western Pennsylvania, I am unable to ascertain.

In Giles County, E. Virginia, at an elevation of five thousand feet, I observed in August, 1867, the following species of birds: *Junco hyemalis*, *Dendrœca icterocephala*, *D. Blackburniæ*, *D. cœrulescens*, *D. maculosa*, *D. virens*, *Myiodioctes Canadensis*, *M. mitralus*, *Parula Americana*, *Mniotilta varia*, *Setophaga ruticilla*. From the season at which these were observed, they evidently bred in the locality in question. They were most of them abundant.

In the high valley of Henderson county, and on the Black, Rich, and other mountains in southern North Carolina in September, 1869, I observed the following: *Junco hyemalis*, *Vireo solitarius*, *Dendrœca coronata*, *D. maculosa*, *D. virens*, *D. cœrulescens*, *D. Blackburniæ*, *Parula Americana*, *Mniotilta varia*, *Myiodioctes mitratus*, *Setophaga ruticilla*. These were also abundant, and no doubt bred in the localities in question.

These species are enumerated as especially northern forms. They pass Philadelphia in latitude 40° in early spring (April and May), on their way to northern breeding places. Rarely a *Setophaga ruticilla* breeds in that region, but the great majority accompany the northern Dendrœcas and the

Vireo solitarius. Of the list, Verrill states that *Mniotilta varia*, *Parula Americana*, *Dendrœca virens*, *D. Blackburniæ*, *D. icterocephala*, *Myiodioctes Canadensis*, *Setophaga ruticilla* and *Vireo solitarius*, breed at Norway, Maine, at the northern limit of the Alleghanian fauna. *Dendrœca coronata* and *Junco hyemalis* migrate still farther north to within the limits of the Canadian fauna, to breed: *D. maculosa*, not breeding at Norway, may have similar habits. The two former birds are regarded by Verrill as true types of the Canadian fauna, the *Junco* representing in part *Spizella socialis* of the Alleghanian, and the *D. coronata* the *D. pinus* of the same.

The southern localities now given for the species of the two lists, I have not found recorded, except in the case of *Junco hyemalis*, which according to Audubon breeds in the Virginian Alleghanies. The species mostly, and especially the last named, are confined like the red squirrel to the most elevated mountain crests. In North Carolina these range from five thousand to six thousand seven hundred and forty feet.

It is also evident that a number of species of birds, mostly wood-warblers (*Dendrœca* and other *Tanagridæ*) have an east and west, as well as north and south migration; passing to and from the Alleghany Mountains, instead of going to the New England States and Canada.

Among the Batrachia a single species is found on the high peaks of the Black Mountains, and its faunal relations are similar to the preceding. This is a species of Salamander, the *Desmognathus ochrophœa*, which is common in that Canadian island, the Adirondack Mountains, and in the Alleghanies as far south as the South of Pennsylvania. In the lower country of New England and New York it appears not to be known to naturalists, though it may occur there, while in Southern Pennsylvania it is not found. Its range extends to the Georgian Alleghanies, as a specimen similar to those from the Black Mountains was sent to the Smithsonian Institution by Dr. Jones.

The preceding species of mammals, birds, and batrachia, accompany very exactly the range of the trout (*Salmo fontinalis*). This well known fish is already in South-western Virginia, confined to the most elevated peaks and knobs, and does not even occur in the streams of many of the mountain valleys. In North Carolina its distribution is quite similar. I took it in the headwaters of the French Broad, and was satisfied that it occurs in the head of the Catawba. Dr. Hardy, of Asheville, who is very familiar with the Southern Alleghany Region, assured me that it is found in the headwaters of the Chattahoochie in Georgia, the only example of its occurrence in a river flowing directly into the Gulf of Mexico, with which I am acquainted. At the same time Dr. Peck of Mossy Creek, Tennessee, who has fished for trout in most of the Alleghany streams, is of the opinion that the fish does not occur in any streams in the Cumberland Mountains.

The wood frog (*Rana sylvatica*) also occurs on the mountains of North Carolina, but what the southern limit of its range in the low lands is, I do not know.

Of the eighteen species above enumerated, at least ten are not found in the southern half or more of the Alleghanian fauna, that is, are not known as residents about Philadelphia, and most of them are not found within a considerable distance north of that point. Of this number at least two belong exclusively to the Canadian fauna, while of the remaining eight, five (*Lynx Canadensis*, *Sciurus Hudsonius*,* *Cervus Canadensis*, *Setophaga ruticilla* and *Salmo fontinalis*), are absent or rare in the low countries south of Philadelphia.

The value of the isothermal of 65° during April, May and June, as a boundary of faunæ may thus be questioned, though it is probably as determinative as any other that

* A friend long resident in Loudon Co., Va. (on the Potomac), informs me that the red squirrel does not occur there. Prof. Baird gives in the 8th Vol., U. S. Pac. R. R. Rep't, measurements of specimens from Mississippi.

could be fixed upon. Thus the limit of the breeding region of the ten northern species above alluded to might be regarded as such a boundary. This would be about the parallel of the mouth of the Connecticut (or Hudson), and it would coincide with the northern limit of several genera and species of fishes. Thus Lepidosteus, Clinostomus, Enneacanthus, Acantharchus and Carpiodes, do not exist north of this point, nor the widely distributed species *Semotilus corporalis* and *Hypsilepis analostanus*. There is, however, nearly as much change at the latitude of the Susquehanna, while at the James, Micropterus, and probably Campostoma, have their northern Atlantic limit.*

II. On the fauna of the Upper Valley of the French Broad River, North Carolina.—This valley is probably the most extensive for its elevation above the sea, in the Appalachian region. It may be said to extend from near Asheville at the southern extremity of the Black Mountains, to near the line of South Carolina, or the Saluda Mountains, north and south. On the east and west it is bounded by the Blue Ridge and the Cold Spring and other ranges, respectively, embracing the counties of Henderson and Transylvania and part of Buncombe. The French Broad River traverses it from south to north, taking its rise in the southern and western bounding mountain ranges. This fine valley is comparatively level, and the soil, though loamy, contains a considerable proportion of sand. The river pursues a level course with but few rapids, and through broad meadows susceptible of high cultivation. The climate is delightfully equable, being without summer heats and winter snows. The magnificent scenery, in views of the surrounding mountains, especially to the westward, have made it the Saratoga of Charleston and Mobile; and its claims,

*In an essay on the distribution of fishes in the Alleghanies of South-western Virginia, I stated, p. 245, that Amblodon does not occur in the Lake district. I have since ascertained, through Professor Agassiz, that it is found in Lake Champlain.

so superior in scenery to that watering place, will no doubt be some day recognized by the citizens of our northern cities.

According to the measurement given by Prof. Kerr, in his first report on the progress of the Geological Survey of the State, the elevation of this valley is twenty-five hundred feet above the sea. The highest point in the great valley of the Alleghanies, on the line of the Virginia and Tennessee Railroad in south-west Virginia, is nineteen hundred feet, according to the railroad surveys. The Black Mountains rise from the Upper French Broad Valley to six thousand seven hundred and forty feet. On the south, three ranges separate it from the upper country of South Carolina, the southern escarpment of each of which presents a much greater descent than the northern.

As might have been expected, the products of this valley approximate, in some respects, those of the North. It is the source of supply for the immediately adjoining southern regions, of apples, potatoes, and cabbages that will head. In its fauna it partakes of a few northern traits. I observed the following birds there in September, so that I cannot be sure that they breed there, or that they had not descended from the surrounding mountains: *Mniotilta varia*, *Parula Americana*, *Dendrœca virens*, *D. cœrulescens*, *D. maculosa*, *Setophaga ruticilla*. The reptile fauna presented on the other hand a marked peculiarity, and I write the present notice to call attention to it. The lizard *Oligosoma laterale* Say, was common; the salamander *Spelerpes guttolineatus* was excessively abundant, and a single example of *Amblystoma talpoideum* was found there under a log, during my residence of a week. These three species have been looked upon as representing our extreme southern Reptile fauna. They have not been found hitherto north of the low country of the Gulf States, and its prolongation up the low valley of the Mississippi. The *Amblystoma* only, of the three, has occurred near Cairo, Ill. (Mus. Smithsonian). The *Speler-*

pes guttolineatus seemed to take the place in habit and manners of our *Plethodon erythronotus*, which did not occur there. The occurrence of these species at that elevation seems quite peculiar, as I did not meet with either of them in three weeks in the valley of Tennessee from ten to thirty miles north of Knoxville, nor in two months in the low country of western, middle and eastern North Carolina, in the latitude of this valley.

Besides these species, there were abundant the widely distributed *Spelerpes bilineatus*, *S. ruber*, *Amblystoma punctatum*, and *Desmognathus fuscus*. *D. niger* and *D. ochrophœus* of the neighboring mountains were not there.

As to the flora of the valley I made but few observations. The buckeyes and Gordonia of the Cumberland Mountains had disappeared, and the universal "stick-weed" (*Actinomeris squamosa*) of the Great Valley was rare. *Aconitum uncinatum* adorned the thickets with its twining stem bearing large blue flowers. The coarse *Silphium terebinthaceum* was conspicuous in the old fields, along with abundance of a common *Cratægus*. In the woods there were three species of *Viburnum*, and the swamps were often well protected against intruders by the *Smilax laurifolia*. The moss supported abundance of the *Sarracenia purpurea*, and a second species, perhaps *S. rubra*.

The latter plant is interesting as furnishing another instance of the dependence between species of different kingdoms, for means of subsistence. The tubular leaves of this species are erect and slender, or trumpet shaped. The delicate hairs with which they are lined increase in coarseness to near the base, while they are so delicate on the inside of the free portion of the leaf as to produce the effect of iridescence. Insects which enter are imprisoned by this arrangement, and I did not examine a specimen, of the many observed, which did not contain at least an inch of dead insects of all orders, in the bottom. On the top of this mass of decay a large dipterous larva was invariably found.

It was not of a kind familiar to me, and seemed evidently to depend for subsistence on the animal matter furnished by the trap-like qualities of the *Sarracenia* leaf. I did not observe any such tenant in the *S. purpurea*, where the hollow petioles were frequently more or less filled with water.

III. On some species of Spelerpes. — In his original descriptions of North American Salamanders, published many years ago by Professor Jacob Green, he mentioned one under the name of *Spelerpes cirrigera*, which was said to have been discovered in Louisiana. This animal was small, and furnished with a marked peculiarity in the shape of a dermal appendage or tentacle, dependent from the upper lip near the nostril. In other respects the animal was allied to the *Sp. bilineatus*, the small species so generally distributed over the United States. In Holbrook's extensive work on herpetology, this species is again described and figured, but no new specimens are mentioned as having been discovered, and it is regarded as very rare. In 1869 the writer made a study of the North American salamanders preserved in the Museum of the Smithsonian Institution, and examined with much interest, among others the types of Green's description of *Spelerpes cirrigera* from Louisiana. A narrow investigation of these convinced me that no other character existed by which to distinguish them from a usual southern variety of *Sp. bilineatus*, than the two peculiar cirri originally observed by Green. Now these cirri are evidently remnants of an early larval character universal among tailed Batrachia, namely, the balancers. These are a long process on each side of the head immediately in front of the branchial processes, which appear very early, indeed almost simultaneously with the latter. They are probably homologous with the beards of the larval Dactylethra of Africa described by Wyman and Gray, which give those tadpoles so much the appearance of Siluroids, or cat-fish. In our salamanders they disappear at various periods of growth, and sometimes leave

traces in the form of an angle or swelling beneath the nostril on the lip, and sometimes as in the supposed species *Spelerpes cirrigera*, as a tentacle, or cirrus. Influenced by this consideration I referred Green's salamanders to his *Sp. bilineatus*.*

In the course of collecting in the Alleghany region of Tennessee and North Carolina, I became satisfied of the propriety of this step. While in the recesses of a cave in the valley of Tennessee, in Jefferson county, I found a very fine specimen of *Spelerpes longicauda* of a red orange color, which had well developed tentacles on each side, precisely as in the cirriferous *Sp. bilineata* of Green. Subsequently in ascending the Black Mountains in Buncombe county, North Carolina, I found five specimens of the typical form of *Sp. bilineata*, of which three were tentaculate, and two were not. Finally, in a considerable number of the *Sp. guttolineata*, from the headwaters of the French Broad in North Carolina, one presented the same feature of well developed tentacles.

This irregular preservation of a larval character, is of interest in connection with the theory of evolution. Should the presence of these tentacles be permanent in any species, it is not to be doubted that the character would be regarded as generic, and justly so. Its history would in that case be like the history of *all other* generic characters as representing the undeveloped stage of another type, if not itself the *ne plus ultra*. Should it be constant in a color variety only of some species, and wanting in other varieties, and in other species, the first would become the type of another genus, whatever its claims to specific distinction might be. The latter would of course follow the former! If, however, the naturalist of the old school had any suspicion that the two forms may have had a common origin, he would ignore the distinctions. The proper course appears to me to recognize characters as definitive when they are *constant*, and discuss their history afterwards.

* See Proceedings of the Academy of Natural Sciences, 1859. p. 107.

ON THE DEEP-WATER FAUNA OF LAKE MICHIGAN.

BY DR. WILLIAM STIMPSON.

A knowledge of the character of the animals and plants living at the bottom of the great North American Lakes, the largest bodies of fresh-water in the world, has long been a desideratum; and dredging operations have this year been initiated by the Chicago Academy of Sciences which have already produced interesting results. The first dredgings were made off Chicago, where the waters were found to be shallow, and the bottom sandy or gravelly. At a distance of eighteen miles from land the depth was but fourteen fathoms. The bottom was nearly barren of life. We obtained, however, specimens of the larva of some neuropterous insect, a *Clepsine*, a flesh-colored leech belonging to a new genus; a *Lymnæa*, two Melanians and a *Plumatella*. The plants consisted of a moss, a *Chara*, a *Nostoc*,and one other alga.

The next investigations were made in the more central and deeper parts of the lake. Dr. Hoy of Racine had been for some time endeavoring to ascertain the nature of the food of the whitefish, which had previously remained entirely unknown. These fish being caught in gill-nets and "pounds," are generally taken from the water some hours after being actually entrapped, and the food in the stomach becomes thoroughly digested, and its character undistinguishable before it can be obtained and examined. Dr. Hoy, however, after long search, succeeded in obtaining some fish in which the contents of the stomach was in a comparatively fresh state, and ascertained it to consist mainly of remains of small crustaceans. These he submitted to me for examination, and among them I had the pleasure of detecting indications of the existence of marine forms in the lake.

It thus became highly desirable to examine the ground upon which Dr. Hoy's fishes had been obtained, and accord-

ingly on the 24th of June last we started out from Racine for the purpose in a tug belonging to that place. The party consisted of Dr. Lapham, Dr. Hoy, Mr. Blatchford and Dr. Andrews of Chicago, and myself. We dredged at various points from twelve to twenty-six miles from land, the greatest depth found being sixty-four fathoms, with a bottom of blackish impalpable mud. Between the distances of twelve and twenty-two miles from shore the depth was tolerably uniform, averaging forty-five fathoms, the bottom being generally a reddish or brownish, sandy mud. On this plateau we obtained alive the crustacea found by Dr. Hoy in the stomachs of the whitefish, consisting of a *Mysis* and two species of *Gammarus*. A small white *Planaria*, and a new species of *Pisidium* also occurred. All of these animals were found in abundance, showing this portion of the lake bottom to be rather densely inhabited.

Mysis is a marine genus, many species of which occur in the colder parts of the North Atlantic and in the Arctic seas. One species, *M. relicta*, was found by Lovén in company with *Idothea entomon* and other marine crustacea in the deep fresh-water lakes, Wenner and Wetter of Sweden, indicating that these basins were formerly filled with salt-water, and have been isolated from the sea by the elevatory movement of the Skandinavian peninsula which is still going on. That the same thing has occurred to our own lakes is shown by the occurrence in their depths of the genus *Mysis*, notwithstanding the non-occurrence of marine shells in the quaternary deposits on their shores. Kingston on Lake Ontario, is, I believe, the highest point in the valley at which such shells have been found. Very probably, at the time when the sea had access to these basins, the communication was somewhat narrow and deep, and the influx of fresh-water from the surrounding country was sufficient to occupy entirely the upper stratum, while the heavier sea-water remained at the bottom. After the basins had become separated from the ocean by the rise of the land, the bottom

water must have become fresh by diffusion very slowly to allow of the gradual adaptation of the crustaceans to the change of element. Possibly the occurrence at the bottom of salt springs like those of the adjacent shores of Michigan may have had something to do with the slowness of the change. At present the bottom water, judging from a specimen we obtained from a depth of fifty fathoms approximately, is entirely fresh.

I am informed by Professor Gill that the *Triglopsis Thompsonii* of Girard is a marine rather than a fresh-water form. This fish inhabits the depths of the lakes, having been found by Professor Baird in the stomach of *Lota maculosa*, taken in Lake Ontario, and recently by Dr. Hoy in those of trout caught off Racine.

Our *Mysis* is allied to certain arctic forms, which would lead us to refer its original entry into the lakes to the cold period of the quaternary epoch. While the marine species usually live near the surface of the water, this one appears to be confined to the bottom, a result of its seeking the colder and at a former period the more saline waters.

The investigation of the materials obtained by the dredging parties of the Academy is now in progress, and the results will be published in full with illustrations at an early period.

CLIMBING PLANTS.

BY PROF. W. J. BEAL.

THE following remarks upon this interesting subject, can scarcely be called a review, but more properly a summary given nearly in the words of the author.* It has been made

*On the Movements and Habits of Climbing Plants. By Charles Darwin, Esq., F.R.S., F.L.S., etc. [From the Journal of the Linnæan Society.] pp. 118. London, 1865.

quite full, as it is likely the original paper has been read by but few readers of the NATURALIST.

Climbing plants may be divided into those which spirally twine round a support; those which ascend by the movement of the foot-stalks or tips of their leaves; those which ascend by true tendrils; those which are furnished with hooks, and those which are furnished with rootlets. The last two exhibit no special movements and are of less interest than the first three.

Spirally Twining Plants.—I begin with a special case, one depending upon my own observation, similar to the one taken by Mr. Darwin. A thrifty hop-vine in my yard went up nine or ten feet to the top of a stake. Still aspiring it ran above the support, at the same time reaching off and swinging round and round following the course of the sun. When about two feet above the stake the tip of the vine circumscribed a circle two feet in diameter. While it grew longer the extent of the circle was about the same, as a part of the vine had become strong and remained nearly stationary. By observations made at different times in the day it was found to perform one revolution in from one to two hours, moving most rapidly in the warmest part of the warmest days. It is now four feet and two inches above any artificial support, and has just tipped over to the north-east in the direction of the prevailing wind. The revolving movement lasts as long as the plant continues to grow, but each separate joint or internode, as it grows old, ceases to move. In the case of the hop and most other twining plants, about three internodes at a time partake of the motion.

The *Hoya carnosa* (*Asclepiadaceæ*) revolves opposite to the sun in five or six hours, making a circle of over five feet in diameter. The tip traced thirty-two inches per hour. It was an interesting spectacle to watch the long shoot sweeping night and day this grand circle in search of some object round which to twine. Sometimes it described nar-

row ellipses. After performing thirty-seven revolutions the stem of a hop was found to be twisted three times round its own axis in the direction of the sun. To prove that the twisting of the stem does not cause the revolutions, as Hugo von Mohl supposed, *some* stems are not regularly twisted and *others* twist in an opposite direction to the revolving plant. In many twining plants the end of the shoot is hooked so as the more readily to hold fast to any object of support which may be caught. This support once found, the point of contact ceases to move, but the tip continues to twine above and around the support as a rope swung around a stick will coil in the direction of the swinging rope.

If a stick shortly after having been wound round be withdrawn, the shoot retains for a time its spiral form, then straightens itself and again begins to revolve. Mohl believed that plants twined because of a dull irritability of the stem, but experiments prove that this is not generally the case.

If the support of a twiner be not lofty it falls to the ground, and resting there the extremity rises again. Sometimes several flexible shoots twine together into a cable and thus support each other. Single thin shoots will fall and turn abruptly back and wind upwards on themselves. The majority of twiners move in a course opposed to that of the sun or the hands of a watch. Rarely plants of the same order twine in opposite directions, but no instance is known of two species of the same genus twining in opposite directions. Of seventeen plants of *Loasa aurantiaca*, eight revolved in opposition to the sun and ascended from left to right, five followed the sun and ascended from right to left, and four revolved and twined first in one direction, and then reversed their course. One of these four plants made seven spiral turns from right to left, and five turns from left to right. Climbers of the temperate zone will not generally twine around thick trees, while those of the tropics can. Unless this were the case those of the tropics could hardly

ever reach the light. In our temperate countries twiners which die down every year would gain nothing as they could not reach the summit in a single season. With most twining plants all the branches, however many there may be, go on revolving together; but, according to Mohl, the main stem of *Tamus elephantipes* does not twine — only the branches. On the other hand, with the asparagus, given in the table, the leading shoot alone, and not the branches, revolved and twined. Some produce shoots of two sorts, one of which twines; the others not. In others the uppermost shoots alone twine. One twines during the middle of the summer but not in autumn. Some grow erect in dry South Africa, their native country; but near Dublin, Ireland, they regularly twine.

Leaf Climbers. — The stems of several species of *Clematis* are twiners like the hop. But in addition to this mode of holding fast, the petioles are sensitive to the touch, slowly bend into the form of hooks, and if successful in catching a stick they clasp it firmly and soon become greatly enlarged and strengthened by an extra growth of woody fibre. If they come in contact with no object they retain this position for a considerable time, and then bending upwards they reassume their original upturned position, which is retained ever afterwards. In *Clematis calycina* the clasped petiole becomes nearly twice as thick as the leaf-stalk which has clasped nothing. The petiole of the unclasped leaf is flexible, and can be easily snapped, whereas the clasped footstalk acquires an extraordinary toughness and rigidity so that considerable force is required to pull it into pieces. The meaning of these changes is plain, namely, that the petioles may firmly and durably support the stem. In some species of *Clematis* furnished with compound leaves the main petiole alone is sensitive, while some have two or three sub-petioles, also sensitive; still others have the entire number, as many as seven, sensitive. Some petioles are extremely sensitive to very light weights, as one-eighth

of a grain. They will clasp thin withered blades of grass, the soft young leaves of a maple, or the lateral flower peduncles of the quaking grass *Briza;* the latter are only about as thick as a hair from a man's beard, but they were completely surrounded and clasped.

The first petiole of *Tropæolum tricolorum* var. *grandiflorum* bear no laminæ or blades, and are very sensitive to touch, sometimes bending into a complete ring in six minutes. The next filaments above have their tips slightly enlarged, and those still farther up the stem still more enlarged; so we find all grades, from tendrils to leaves with large blades. All of these petioles are sensitive; those without blades acting in every way like genuine tendrils; the latter are short lived, however, dropping off as soon as the petioles of the true leaves have clasped the support above. The most remarkable fact, and which I have observed in no other species of the genus, is that the filaments and petioles of the young leaves, if they catch no object, after standing in their original position for some days, spontaneously and slowly move, oscillating a little from side to side towards the stem of the plant. Hence all the petioles and filaments, though arising on different sides of the axis, ultimately bend towards and clasp either their own stem or the supporting stick. The petioles and filaments often become, after a time, in some degree contracted, presenting features much like true tendrils.

Maurandia semperflorens (*Scrophulariaceæ*) has flower peduncles which are sensitive like tendrils, and exhibit revolving powers. These spontaneous movements seem to be of no service to the plant as they lose the power when the flower is old enough to open. The leaf-stalks and internodes of this plant do not twine.

Lophospermum scandens var. *purpureum* when young has sensitive internodes. When a petiole clasps a stick it draws the base of the internode against it; and then the internode itself bends towards the stick, which is thus

caught between the stem and the petiole as by a pair of pincers. The internode straightens itself again, excepting the part in contact with the stick.

With *Solanum jasminoides* (Fig. 88) as in no other leaf-climber examined, a leaf grown to its full size was capable of clasping a stick; but the movement was extremely slow, requiring several weeks. On comparing a thin transverse slice of this petiole with one from the next or older leaf beneath, which had not clasped anything, its diameter was found to be fully doubled, and its structure greatly changed. In the section of the petiole which had during several weeks clasped a stick, the two upper ridges have become much less prominent, and the two groups of woody vessels beneath them much increased in diameter. The semilunar band is converted into a complete ring of very hard, white, woody tissue, with lines radiating from the centre. The three groups of vessels, which, though closely approximate, were before distinct, are now completely blended together. This clasped petiole had actually become thicker than the stem close beneath; due chiefly to the greater thickness of the ring of wood.

Fig. 88.

Solanum jasminoides.

Plants belonging to eight families are known to have clasping petioles, and plants belonging to four families climb by the tips of their leaves. With rare exceptions the petioles are sensitive only whilst young; they are sensitive on all sides, but in different degrees in different plants.

Tendril-bearing Plants. — By tendrils are meant filamentary organs, sensitive to contact and used exclusively

for climbing. They are formed by the modification of leaves with their petioles, of flower-peduncles, perhaps also of branches and stipules. The species of tendril bearers described belong to ten natural families. Species of *Bignonia* and some others taken together, afford connecting links between twiners, leaf-climbers, tendril-bearers, and root climbers. Some little time after the stem of *Bignonia Tweedyana* has twined round an upright stick, and is securely fastened to it by the clasping petioles and tendrils, it emits at the base of its leaves aërial roots which curve partly round and adhere to the stick; so that this one species of *Bignonia* combines four different methods of climbing, generally characteristic of distinct plants, namely, twining, leaf-climbing, tendril-climbing, and root-climbing.

The movements of *Bignonia venusta* are quite complicated. Not only the tendrils but the petioles bearing them revolve; these petioles, however, are not in the least sensitive. Thus the young internodes, the petioles, and the tendrils, all at the same time, go on revolving together, but at different rates. Moreover the movements of the opposite petioles and tendrils are quite independent of each other. One other curious point remains to be mentioned. In a few days after the toes have closely clasped a stick, their blunt extremities become, though not invariably, developed into irregular disk-like balls, which have the singular power of adhering firmly to the wood.

The simple undivided tendril of *Bignonia speciosa* ends in an almost straight, sharp, uncolored point. The whole terminal part exhibits an odd habit, which in an animal would be called an instinct; for it continually searches for any little dark hole into which to insert itself. The tendrils slowly travel over the surface of the wood, and when the apex came to a hole or a fissure it inserted itself, often bending at right angles to the basal part. The same tendril would frequently withdraw from one hole and insert its point into a second one. Mr. Darwin says: "Improbable as this view may be

I am led to suspect that this habit in the tendril of inserting its tip into dark holes and crevices has been inherited by the plant after having lost the power of forming adhesive disks."

A plant of *Bignonia capreolata* was several times shifted in position in a box where one side only was exposed to the light; in two days all six tendrils pointed with unerring truth to the darkest corner of the box, though to do this each had to bend in a different manner. Six tattered flags could not have pointed more truly from the wind than did these branched tendrils from the stream of light which entered the box. When a tendril does not succeed in clasping a support it bends downwards and then towards its own stem, which it seizes, together with the supporting stick, if there be one. If the tendril seizes nothing it does not contract, spirally, but soon withers away and drops off. A bunch of wool was placed in the way of the tendrils; they caught one or two fibres and then the tips began to swell into irregular balls above the one-twentieth of an inch in diameter. The surfaces of these balls secrete some viscid resinous matter, to which the fibres of the wool adhere, so that after a time fifty or sixty fibres are all deeply imbedded in one ball of tendril. These tendrils quite fail to attach themselves to a brick wall. These plants are especially adapted to climb trees clothed with lichens and mosses which abound on the trees in the native country of the *Bignonia*.

Cobœa scandens (*Polemoniaceæ*) is an admirable climber. The terminal portion of the petiole which forms the tendril is sometimes eleven inches long. The tendril performs one revolution against the sun in an hour and a quarter. The base of the petiole and the internodes do not move at all.

A large majority of the tendrils of *Corydalis claviculata* still bear leaflets, though excessively reduced in size. We here behold a plant in an actual state of transition from a leaf-climber to a tendril-bearer. Whilst the plant is young, only the outer leaves, but when full-grown all the leaves, have their extremities more or less perfectly converted into tendrils.

Echinocystis lobata. A thin, smooth, cylindrical, stick was placed so far from a tendril that its extremity could only curl half or three-quarters round the stick. It was always found in the course of a few hours afterwards that the tip had managed to curl twice or even thrice quite round the stick. Measurements showed that this was not due to the growth of the tendril. Whilst the tendril was slowly and quite insensibly crawling onwards it was observed that the whole surface was not in close contact with the stick. The onward movement is supposed to be slightly vermicular, or that the tip alternately straightens itself a little and then again curls inwards, thus dragging itself onwards by an insensibly slow, alternate movement, which may be compared to that of a strong man suspended by the ends of his fingers to a horizontal pole, who works his fingers onwards until he can grasp the pole with the palm of his hand. Experiments upon this interesting plant were made and the results published by Dr. Asa Gray, in 1858. This led Mr. Darwin to more extended observations upon many other climbing plants. He is only one of a large number of persons who are indebted for valuable hints from the sagacious botanist of Cambridge, Mass.

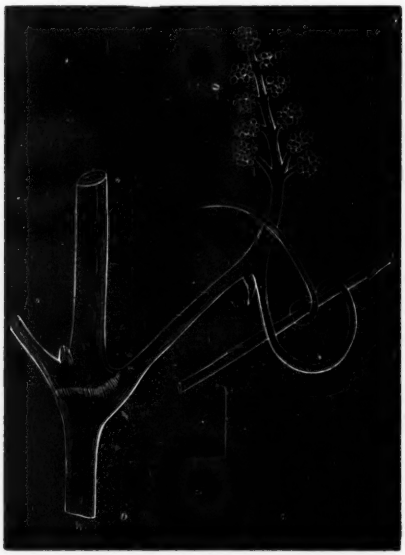
Hanburya Mexicana. In a few days after the tips of the tendrils have grasped an object the inferior surface swells and becomes developed into a cellular layer, which adapts itself closely to the wood, and firmly adheres to it. This is not the extreme tip of the tendril but a trifle back of it. This layer apparently secretes some resinous cement, as it is not loosened by water or alcohol, but is freed by the action of ether and turpentine.

Tendrils of plants belonging to *Vitaceæ*, *Sapindaceæ*, *Passifloraceæ*, and perhaps others, are modified flower peduncles, but their homological nature makes no difference in their action. Figure 89 shows part of the tendril of a grape-vine bearing flowers. From this state we can trace every stage till we come to a full-sized common tendril, bearing on

the branch which corresponds with the sub-peduncle one single flower-bud!

Ampelopsis quinquefolia (Fig. 90, tendril, with the young leaf. Fig. 91, tendril, several weeks after its attachment to a wall, with the branches thickened and spirally contracted, and with the extremities developed into disks. The unattached branches have withered and dropped off.) climbs by tendrils like the grape-vine, but in addition has a way of holding fast to plain surfaces by means of little disks or cushions. These disks are apparently never developed without a contact with some object. A tendril which has not become attached to any body does not contract spirally; and in course of a week or two shrinks into the finest thread, withers and drops off. An attached tendril, on the other hand, contracts spirally, and thus becomes highly elastic; so that when the main foot-stalk is pulled, the strain is equally distributed to all the attached disks. During the following winter it ceases to live but remains firmly attached to the stem and to the surface of attachment. The gain in strength and durability in a tendril after its attachment is something wonderful. They adhere still strong after an exposure to the weather for fourteen or fifteen years. One single lateral branchlet of a tendril, estimated to be at least

Fig. 89.



Grape-vine.

ten years old, was still elastic and supported a weight of exactly two pounds. This tendril had five disk-bearing branches of equal thickness and of apparently equal strength, so that this one tendril, after having been exposed during ten years to the weather, would have resisted a strain of ten pounds!

Spiral Contractions. — Tendrils of many kinds of plants if they catch nothing, contract after an interval of several

Fig. 90.

Woodbine.

days or weeks into a close spire. A few contract into a helix.

The spiral contraction which ensues after a tendril has caught a support is of high service to all tendril-bearing plants; hence its almost universal occurrence with plants of widely different orders. When caught the spiral contraction drags up the shoot. Thus there is no waste of growth, and the stretched stem ascends by the shortest course. A far more important service rendered by the spiral contraction is that the tendrils are thus made highly elastic. The strain, as in *Ampelopsis*, is thus equally distributed to the several attached branches of a branched tendril. It is this elasticity which saves both branched and simple tendrils from being torn away during stormy weather. In one case observed

the *Bryony* (Fig. 92) safely rode out the gale, like a ship with two anchors down, and with a long range of cable ahead to serve as a spring as she surges to the storm. When an uncaught tendril contracts spirally the spire always runs in the same direction from tip to base. A tendril, on the other hand, which has caught a support by its extremity, invariably becomes twisted in one part in one direction, and in another part in the opposite direction; the oppositely turned spires being separated by short, straight portions.

Fig. 91.

Woodbine.

Sometimes the spires of a tendril alternately turn as many as five times in opposite directions, with straight portions between them; even seven or eight have been seen by M. Léon. Whether few spires, or many, there are as many in one direction as in the other. To give an illustration; when a haberdasher winds up ribbon for a customer he does not wind it into a single coil; for, if he did, the ribbon would twist itself as many times as there were coils; but he winds it into a figure of eight on his thumb and little finger, so that he alternately takes turns in opposite directions, and thus the ribbon is not twisted. So it is with tendrils, with this sole difference, that they take several consecutive turns in one direction, and then the same number in an opposite direction; but in both cases the self-twisting is equally avoided. *Passiflora gracilis* has the most sensitive tendrils which were seen; a bit of

platina wire, one-fiftieth of a grain in weight, gently placed on the concave point, caused two tendrils to become hooked. After a touch the tendril began to move in twenty-five seconds. Dr. Asa Gray saw tendrils of *Sicyos* move in thirty seconds. Other tendrils move in a few minutes; in the *Dicentra* in half an hour; in the *Smilax* in an hour and a quarter; and in the *Ampelopsis* still more slowly. Tendrils move to the touch of almost any substance, drops of water excepted. Adjoining tendrils rarely catch each other. Some tendrils have their revolving motion accelerated and retarded in moving to and from the light; others are indifferent to its action. America which so abounds with arboreal animals

Fig. 92.

Bryony.

abounds with climbing plants; and, of the tendril-bearing plants examined the most admirably constructed come from this grand continent, namely, the several species of *Bignonia*, *Eccremocarpus*, *Cobœa*, and *Ampelopsis*.

Root Climbers. — *Ficus repens* climbs up walls just like ivy; when the young rootlets were made to press lightly on slips of glass they emitted, after about a week's interval, minute drops of clear fluid, slightly viscid. One small drop the size of half a pin's head, was mixed with grains of sand. The slip of glass was left exposed in a drawer during hot and dry weather. The mass remained fluid during one hundred and twenty-eight days; how much longer was not observed. The rootlets seem to first secrete a slightly viscid

fluid and then absorb the watery plants, and ultimately leave a cement.

Plants become climbers, in order, it may be presumed, to reach the light, and to expose a large surface of leaves to its action and to that of the free air. This is effected by climbers with wonderfully little expenditure of organized matter, in comparison with trees, which have to support a load of heavy branches by a massive trunk. Because these climbing plants graduate into each other they have "become" climbers by gradual changes. This looks too much like the old fanciful theory that has again and again appeared, namely, the giraffe acquired his long neck by a constant desire for high twigs, and an effort to reach them; the elephant his long trunk by a similar desire and effort to reach the grass at his feet. We cannot see how homology indicates descent. We do not believe because the various modes of inflorescence run into each other (*homologous*) that they have all been derived from one common form. Mr. Darwin believes that leaf-climbers were primordially twiners, and tendril-bearers were primordially leaf-climbers; and thinks he understands how the change has been brought about; yet he says "if we inquire how the petiole of a leaf, or the peduncle of a flower, or a branch, first becomes sensitive and acquires the power of bending towards the touched side, we get no certain answer." We are again silenced if we inquire how the stems, petioles, tendrils, and flower peduncles first acquired their power of spontaneously revolving. Below we give a good sample of Darwinism.

"If these views be correct *Lathyrus nissolia* must be descended from a primordial spirally-twining plant; that this became a leaf-climber; that first, part of the leaf, and then the whole leaf became converted into a tendril, with the stipules by compensation greatly increased in size; that this tendril lost its branches and became simple, then lost its revolving-power (in which state it would resemble the tendril of the existing *L. aphaca*), and afterwards losing its pre-

hensile power and becoming foliacious, would no longer be called a tendril. In this last stage (that of the existing *L. nissolia*), the former tendril would reassume its original function of a leaf, and its lately largely developed stipules being no longer wanted would decrease in size." He believes that the capacity of acquiring the revolving power on which most climbers depend is inherent, though undeveloped, in almost every plant in the vegetable kingdom. Notwithstanding his peculiar views, which are so enticing to many, we must acknowledge that he is a shrewd and accurate observer, and that in this paper, as in many others, he has patiently collected a vast amount of valuable information upon a great variety of subjects.

REVIEWS.

NATURAL SELECTION.* — Mr. Wallace has here brought together, in a compact little book, all those essays which have laid the foundation of his great reputation as the author, in common with Mr. Darwin, of the theory of Natural Selection. The modesty of the author, and that admirable judicial coolness of mind which he shares in common with Darwin, is a most persuasive introduction, and produces a favorable disposition in the mind of the reader, which the candid style of treating the different subjects greatly strengthens. In fact we have rarely read a work which has given us so much pleasure and information, and we recommend it to all those who desire to get the principles of Darwinism but have not the patience to spend a longer time over Darwin's work.

The first chapter shows that geological changes determine the variations which take place in the geographical distribution of animals and plants; that closely allied animals are closely associated geographically and geologically, so that "every species has come into existence coincident both in time and space with a prëexisting closely allied species." The author then proceeds to show how variations in animals occur, and incidentally introduces an ingenious and remarkable explanation of the reversions of domesticated types when returned to a feral condition. A domesticated type, when allowed to become wild again, generally speak-

*Contributions to the Theory of Natural Selection. A Series of Essays by Alfred Russell Wallace, McMillan & Co., London and New York, 8vo, p. 384.

ing possesses modifications which are exceedingly disadvantageous; thus they must either regain the original characteristics of their ancestors or become extinct.

In treating of mimicry, or the protective resemblance which many insects have to the bark and leaves of trees, Mr. Wallace is particularly forcible and happy in his illustrations. The *Kallima inachis* and *K. paralexta* are perhaps the most remarkable examples of mimicry. In these two species the wings, when folded, precisely resemble a dead leaf, and since these insects never alight except on withered bushes, they are almost sure to escape detection. "We thus have size, color, form and habits all combining together to produce a disguise which may be said to be absolutely perfect." In the same manner numerous instances are given of similar resemblances occurring between animals in which a harmless species is protected by assuming a resemblance to another species endowed either with stings, disagreeable secretions, or some other peculiarities which render them obnoxious as objects of prey or food to birds. As we have before remarked in dealing with Darwinian theories, we cannot see in all this that natural selection is by any means the primary cause of variation.

Granting that all the variations occur as explained, it seems to become more and more evident that physical changes, or some other unknown causes, give the initiatory impetus to change. According to both Darwin and Wallace a variation must appear, and this variation must in some shape better adapt the animal to its surroundings, its physical wants, before natural selection can act. Thus in the experience of all practical naturalists it acts in such a manner that species have certain local characteristics which they share in common with other species from the same locality. Again, as cited by Wallace, the rise of a mountain system, or other geological revolutions, may produce great changes in the climate and corresponding revolutions in the flora and fauna of a region. We have never been able clearly to see why the plasticity of the organization, and the tendency to vary in any advantageous direction, as seems to be proved by the cases of protective mimicry, might not be acted upon with equal facility by physical causes, natural selection being only the secondary means by which these variations are perpetuated or transferred from individual to individual.

To our minds one of the most remarkable portions of this book is the bold and successful application of the theory to man, and the last chapter which treats of the limitations of natural selection.

It is shown that natural selection would cease to act upon the body after man had once reached a period at which the intellectual faculties began to appear, since then all necessity for farther physical change would be at an end.

"We are now, therefore, enabled to harmonise the conflicting views of anthropologists on this subject. Man may have been, indeed I believe must have been, once a homogeneous race; but it was at a period of which we have as yet discovered no remains, at a period so remote in his

history, that he had not yet acquired that wonderfully developed brain, the organ of the mind, which now, even in his lowest examples, raises him far above the highest brutes;—at a period when he had the form but hardly the nature of man, when he neither possessed human speech, nor those sympathetic and moral feelings which in a greater or less degree everywhere now distinguish the race. Just in proportion as these truly human faculties became developed in him, would his physical features become fixed and permanent, because the latter would be of less importance to his well being; he would be kept in harmony with the slowly changing universe around him, by an advance in mind, rather than by a change in body. If, therefore, we are of opinion that he was not really man till these higher faculties were fully developed, we may fairly assert that there were many originally distinct races of men; while, if we think that a being closely resembling us in form and structure, but with mental faculties scarcely raised above the brute, must still be considered to have been human, we are fully entitled to maintain the common origin of all mankind."

With regard to the limits of the action of this law we quote the following interesting and important argument:

"Mr. Darwin himself has taken care to impress upon us, that "natural selection" has no power to produce absolute perfection but only relative perfection, no power to advance any being much beyond his fellow beings, but only just so much beyond them as to enable it to survive them in the struggle for existence. Still less has it any power to produce modifications which are in any degree injurious to its possessor, and Mr. Darwin frequently uses the strong expression, that a single case of this kind would be fatal to his theory. If, therefore, we find in man any characters, which all the evidence we can obtain goes to show would have been actually injurious to him on their first appearance, they could not possibly have been produced by natural selection. Neither could any specially developed organ have been so produced if it had been merely useless to him, or if its use were not proportionate to its degree of development. Such cases as these would prove, that some other law, or some other power, than "natural selection" had been at work."

The author than proceeds to show that the brain of the savage is uselessly large, being on an average over two and a half times the capacity of that of a Gorilla and nearly seven-eighths of the average Caucasian, or civilized European. This reserve power in the savage, as shown by the size of the unused brain, cannot be accounted for by natural selection, since it is evidently, as shown above, something provided which is not in use and for which a daily necessity does not exist.

The hairless condition of the back in man is also, as pointed out by Mr. Wallace, a characteristic which among naked savages is decidedly a disadvantage and equally unaccountable on the principles of natural selection.

We have already pointed out in previous reviews other cases in which exceptions to the action of the law of natural selection might be found, especially among the fossils. Instead of repeating these remarks we would refer the reader to a series of articles published in the "Scientific Opinion."* These present, by far, the ablest refutation of the universality of application claimed for the great theory of the day. This, together with Professor Dawson's "Modern Ideas of Derivation," reviewed in a previous number of this magazine, and Professor Cope's "Origin of Genera," give fair views of the principal arguments urged against the somewhat unquestioning and hasty acceptation of Darwinism which seems to have become the fashion.

* The Difficulties of the Theory of Natural Selection. Scientific Opinion, Nov. 10, Dec. 1, 1869. Nos. 54-57, Vol. 2.

And here permit us to repeat, by way of explanation, that Darwinism does not mean the theory of development or derivation, pure and simple, as so many insist, but that explanation of its action by the law of natural selection which is given by Wallace and Darwin. We have no objections to urge against the theory which accounts for the origin of species by descent from some ancient and simpler forms, which might be appropriately called Lamarckianism, but only against the universality of the law of natural selection. This is applied to the solution of the origin of all the various modifications of form and characteristics which have arisen since the first appearance of life upon the globe, whereas it is evidently only a secondary law, active perhaps in all species but subordinated to some other and more comprehensive law still undiscovered.

As regards the origin of man himself our author takes the ground that "some higher intelligence may have directed the process by which the human race was developed by means of more subtle agencies than we are acquainted with.

At the same time I must confess, that this theory has the disadvantage of requiring the intervention of some distinct individual intelligence, to aid in the production of what we can hardly avoid considering as the ultimate aim and outcome of all organized existence — intellectual, ever-advancing, spiritual man. It therefore implies, that the great laws which govern the material universe were insufficient for his production, unless we consider (as we may fairly do) that the controlling action of such higher intelligences is a necessary part of those laws, just as the action of all surrounding organisms is one of the agencies in organic development. But even if my particular view should not be the true one, the difficulties I have put forward remain, and I think prove, that some more general and more fundamental law underlies that of "natural selection." The law of "unconscious intelligence" pervading all organic nature, put forth by Dr. Laycock and adopted by Mr. Murphy, is such a law; but to my mind it has the double disadvantage of being both unintelligible and incapable of any kind of proof. It is more probable, that the true law lies too deep for us to discover it; but there seems to me, to be ample indications that such a law does exist, and is probably connected with the absolute origin of life and organization.

In this connection read the original thoughts in the closing paragraphs on "The Nature of Matter," "Matter is Force," "All Force is probably Will-force," expressed in brief thus: "if, therefore, we have traced one force, however minute, to an origin in our own WILL, while we have no knowledge of any other primary cause of force, it does not seem an improbable conclusion that all force may be will-force; and thus, that the whole universe is, not merely dependent on, but actually *is*, the WILL of higher intelligences or of one Supreme Intelligence."

AMERICAN MICROSCOPES AND THEIR MERITS.* — The first of these papers is an elaborate attempt at an account of American microscopes and their merits; but should have more properly been entitled an attempt to describe the microscopes made by R. B. Tolles, as of the twenty-five pages which it covers, twenty are given to Tolles. The second article

* On the North American Microscope. By Dr. H. Hagen, Cambridge, Mass. Max Schultz's Archiv fur Microscopische Anatomie. Bonn. 2d No. 1870. A communication by Dr H. Hagen on his experience in the use of the microscope. Proceedings of the Boston Society of Natural History, vol. xii, p. 357. March 10th, 1869. A verbal communication on Tolles's and Scheick's microscopes, to the Boston Society of Natural History, November 10th, 1869. Unpublished.

above named, but first in time, is noticed here merely to illustrate some points in the first, and the third, because it was preliminary to the first, which only elaborates more in detail what Dr. Hagen said in his verbal communication, and repeats statements and assertions which at the time they were made, Dr. Hagen was informed, by those as fully competent, to say the least as himself, were erroneous; but in this first named paper Dr. Hagen sees fit to entirely ignore the refutations, and makes the same statements deliberately again, as though there had been no contradiction of them. There is no other course left for those who know him to be wrong or feel aggrieved by his statements, than to examine his qualifications for pronouncing judgment, and to show wherein he is mistaken.

Dr. Hagen being a man of acknowledged scientific acquirements, and holding a reputable position at Cambridge, his opinions, given on a professed detail of facts, and after a *claimed careful study* of two years, published in a journal of high repute in Europe, will command attention and respect there, among those who have no opportunity to see and judge for themselves. If he had stated facts correctly his paper might have been left to itself to refute his "opinions." No one can object to any comparison of American instruments with others; it is only asked that the comparison shall be made fairly, and by a competent expert. The writer proposes to show that Dr. Hagen's investigation has been superficial and inadequate to the task he undertook; and that he has mistaken facts and repeated assertions after he had been informed that they were erroneous.

Dr. Hagen opens his first communication to the Boston Society of Natural History by saying: "Having worked with the microscope more than thirty years for medical and scientific purposes — following the gradual perfecting of the instrument — I was anxious to examine the power [?] of American microscopes." This passage sets forth his claim to be a competent critic.

"During the past ten years there has been great competition among opticians, but in every case their progress has been arrested by one insurmountable obstacle." [What one?] "Since the *recent* improvement in correcting objectives for the thickness of covering glasses, comparatively little has been done." Why he should have restricted the "great competition" to the last ten years, and called the improvements in objectives "recent," when the competition in London has been active for forty years, and the "improvement" was made by Ross nearly or quite thirty years ago, can only be explained by supposing what has been generally believed to be the fact, that the "improvement" and the competion had not reached Germany until the last ten years. So far from little having been done since the "improvement" so much *has been done in England* that the London Microscopical Society, which procured objectives of the "three" leading London artists in about the year 1845, in 1867–8 abandoned the whole of them as behind the times, and obtained new ones of the same makers.

Dr. Hagen then makes some very just observations on "the difference in the aberration of the eyes of the observers. There is no doubt that different observers obtain different results with the same instrument." This is an important fact and an important admission from Dr. Hagen. It is well known to many microscopists, but is generally ignored. It is a pity that it did not occur to Dr. Hagen to remember what he had written in March, when he in October recorded some of his own observations.

The paper in the "Archiv" begins by saying for the past twenty years that the "prominent excellence of American microscopes have been frequently mentioned" and it has been "asserted that their achievements have essentially excelled those of European make." "To my knowledge a direct proof of this has never been exhibited, it has not been shown that anything has been ever better seen than with European instruments." "Thus the American instrument constituted until recently a myth towards which all interested in this branch of science gazed with anxious curiosity, and prompted me during my two years residence in this country, to become *thoroughly acquainted* with it, and I have *spared no pains* to study them carefully." Here we have distinctly the task set forth, and the claim that he spared no pains to accomplish it. Two years of the spare time of a busy man was rather short for the undertaking, especially for one with an imperfect knowledge of the English language. Let us see what were the "pains" taken. "The members of the microscopical section of the Boston Society of Natural History, especially Mr. Bicknell of Salem, Mr. Greenleaf of Boston, Professors Agassiz and Gibbs, Mr. Edwards of New York, and Mr. Tolles himself, have kindly seconded my efforts." Four of these gentlemen certainly were competent to assist. The writer cannot say what Mr. Edwards or Professors Agassiz and Gibbs did for assistance; but he states positively that neither Mr. Greenleaf or Tolles "assisted;" that Mr. Bicknell was the only one of the three who had any intimation whatever of Dr. Hagen's intention of becoming "thoroughly acquainted" with the American microscope, for the purpose of publication; they were never *asked to assist* for any such purpose. Had Dr. Hagen not spared his "pains;" had he enquired for those who could have "assisted" him in his "study" and have given him "positive proofs," he would have been referred to Professor Holmes and Professor Bacon of his own university, and to Professor Smith of Hobart College, New York — *Microscopists* who have made a study of the microscope for twenty years — to Dr. Barnard, Pres. Columbia College, New York; to Professor H. J. Clarke of the Kentucky University; to J. E. Gavit, Esq., of New York; to Dr. F. W. Lewis of Philadelphia; to Professor C. Johnston of Baltimore, to Mr. J. S. C. Greene, jr., of Boston; gentlemen who have made the comparison of European microscopes of the *best makers*, with American instruments almost a specialty; had he done this his study might have produced more correct results; that is if he had given heed to the information he received — for he seems to have disregarded that which he obtained from Messrs. Greenleaf and Bicknell.

Dr. Hagen gives his "general opinion" before giving the details, and says "novelty of any importance is not obtained." Yet before he concludes his paper he enumerates six novelties, all invented or designed by Tolles, namely: his binocular eye-piece; the illuminator of opaque objects with high powers; the low power immersion lens; the solid eye-piece; the mode of effecting adjustment for covering glass, and the amplifier; and overlooks others quite important by Tolles and Zentmeyer.

"Objectives and oculars accomplish with slight variations as much as the best European, never more; on the contrary English and French objectives have accomplished some things which the American have hitherto failed to do." It is not the purpose of this paper to produce evidence outside of Dr. Hagen's own statements, as to what American objectives have done. It is only needful to contrast what he says above with what he says he himself saw. Dr. H. says "that an objective 1-10th inch with ocular C. showed while band 19 [of the Nobert test plate] was in the centre of the field, the 18th, 17th, and half of the 16th bands; the lines in all were *well defined*, but not so that I could have counted them all. I could *count about forty* of the 19th, the rest blurred." "None of Tolles' objectives have well resolved the 16th to 19th bands of Nobert's plates which has been done with the 1-16th of Powell and Lealand." It would seem incredible that the same person could have written the above lines in the same paper; most especially after he had been positively informed by five gentlemen that they had seen the 19th band resolved, and with *several* of Tolles' objectives. But Dr. Hagen takes the ground (though not in this paper, as he should have done) that because *he* did not *count all the lines* at once, that they were not resolved; and it is true that he is not alone in that theory. To show the absurdity of this we will suppose that Nobert had ruled in the 19th band only 28 lines instead of 57, would Dr. Hagen say they were not resolved, when he saw the whole, because there were no more? Or if Nobert had covered a whole inch with the 112,000 and some odd lines, would any one claim that they must all be seen at once? If either of these suggestions are answered in the negative, then Dr. Hagen has himself seen the 19th band resolved with a Tolles' objective. But Dr. Hagen says that American objectives have done "never more than European," and yet what he did with a 1-10th objective, is much "more" than to see all the lines with a 1-16 (really a 1-20). He never saw, read of, or heard of a 1-10 European objective that would do what that one accomplished. This is not all; his sight of the *Surirella gemma* gives the same contradiction to his "opinion." He says "*S. gemma* with the same 1-10 showed only in a few places oblong fields between the cross lines, but not well defined or regular as in Hartnack's drawings." Well, did any one ever see them so? If Dr. Hagen knew as much of diatoms as of insects, he would have been aware of the fact that Hartnack's figure is a theoretical diagram, not a representation of the appearance in the microscope. Probably the only person living who claims to have seen what Hartnack calls the "flat hexagons,"

is Mr. Bicknell, who says he saw them, and only with a Tolles' 1-12. Hartnack does not say distinctly that he has seen them with a 1-16; he attempted to show them to two accomplished microscopists, and both failed to see them. Dr. Eulenstein has also failed with Hartnack's Nos. 10, 11 and 12, Powell and Lealand's 1-50 and Ross' objectives; and Dr. Hagen knew these facts, for the writer told him before his paper was written; comment is unnecessary. Dr. Hagen also says that Hartnack's 1-16 has resolved *S. gemma*, and Tolles' 1-10 has not, ergo Hartnack's has done what Tolles' could not. Dr. Hagen has himself furnished the "direct proof" he wanted of the "unsurpassed excellence" of the American objective.

Now for some of Dr. Hagen's errors and mistakes. He says of Tolles' objectives "the workmanship is superb," "the adjustment only moves the lower lens from the two others." The solid eye-pieces are "really biconvex Coddington lenses." He gives on the authority of Edwards a formula of Tolles' objectives; all there is to be said, is, that the formula is not Tolles' formula, the eye-pieces are not Coddington lenses, and that Tolles had never made objectives to move the front lens; all of which Dr. Hagen could have easily ascertained.

Dr. Hagen considers that "a most important fault of the instrument consists in the difficulty of its use. In order to adjust them so that they will give their greatest results requires delicate labor and considerable time. In this respect they are excelled by the higher as well as the lower powers of English and German." "The ease of treatment of Hartnack's and Scheick's highest objectives is certainly far less troublesome." If this means anything it must refer to the delicacy of the adjustment for covering glass. Undoubtedly Scheick's are far less troublesome. It is thought to be well known to microscopists that the delicacy of this adjustment — consequently in one sense the difficulty of use — is increased just in proportion to the approach to perfection of the lenses. Certain it is that Hartnack when delivering an objective made for a member of the Boston Society of Natural History two years ago, called the purchaser's attention especially to the fact that when an object was best shown, the movement of the adjusting ring one hundredth of an inch either way destroyed the effect, as an evidence of the perfection of his work. As to English objectives. Dr. Piggott in a recently published article on high power objectives, speaks of a certain effect being entirely destroyed by a change of this adjustment which moved the lens only 1-14,000 of an inch. So much for English lens and Hartnack's. Microscopists know that Dr. Hagen is in an error as to good objectives, but correct if his remarks are applied to poor ones; and it is not surprising that he was "*utterly astonished* to see how much more the hand of the artist himself will develop with the instrument."

The majority of the microscopists here are "dilletanti or workers on diatoms;" this must be news to Professors Holmes, Bacon, Ellis and Gray, and to their hundreds of past and present students; the "truth will be

respected" if it is said that there are hardly enough diatomists in the whole country to encourage each other.

Dr. Hagen thinks that his attempt at "even pronouncing a judgment on the local instruments, caused a storm of indignation against me by the resident microscopists," and accounts for it by the assertion that "*we know* that most of them are members of the Boston Optical Association." Dr. Hagen here refers to the reception of his verbal communication to the Boston Society of Natural History in November last. Of all the persons then present but two were members of that association, and whatever indignation was manifested was at his preposterous comparisons of cost. Dr. Hagen then asserted that the American instruments cost 600 per cent. more than German of equal merit, and that "English objectives of the most celebrated makers could be imported to advantage." In his paper in the "Archiv" Dr. Hagen reduces the comparative cost of German and French objectives to "one-third or one-fourth as much," but repeats his comparison as to the English "according to Frey's statement." Now before this paper was written the cost of importing English objectives was read in detail to Dr. Hagen, and it was shown from the makers' price lists that the cost was much higher than Tolles' prices for similar objectives, and yet Dr. Hagen elects to repeat his erroneous statement. He said then that he "spoke for the interest of science." Can the interest of science be promoted by such misstatements? It was not the intention of the writer to have said anything more on the matter of cost, but while writing this paper a letter was received, an extract from which is a good comment on all that Dr. Hagen has said as to cost and workmanship. It is not known that the writer of the letter ever heard of Dr. Hagen or his comparisons. The letter was written by Colonel J. G. F. Holston, M.D., Washington, D.C., June, 1870. "I was never dissatisfied either with Tolles' prices or his workmanship, for although apparently dearer than some other makers, the superior excellency more than balances it. I can do with my 1-12th by Tolles (cost $100), all that Powell and Lealand's 1-50th will do well that cost the United States $350. I compared them myself at the museum." Dr. Barnard, President of Columbia College, New York, writes, "Dr. Hagen is absurdly wrong in his comparison of the performance of the American and foreign objectives of the same price." "It is nonsense to make such comparisons as these price for price."

No less unfortunate is Dr. Hagen in his description of Tolles' first class instruments; he partially describes the plan and construction of some instruments which he had seen — omitting, however, some of the most peculiar details — and mixing with that some of the peculiarities of an unique instrument, the only one of the kind ever made, and which he has never seen, the particulars of which he could have got from Dr. Barnard's report of the Paris Exposition of 1867 — constructing in this way an instrument which has no existence. He claims to have "seen and tested nine of Tolles' instruments of the largest class." The writer will

not say that is impossible, but he can say that there are no nine instruments of the "largest class" known to Mr. Tolles that Dr. Hagen could possibly have seen and tested. His classification must be treated as an error until he furnishes a list of the nine. The self-sufficiency with which he charges the reverend President of Columbia College with making, in his official report of the Paris Exposition, a claim that is "hardly tenable" is, to use his own expression, "quite comical." Dr. Barnard had reported that "it was to be regretted that the American makers did not send" stands to the exhibition; for the want of them the objectives were not properly examined. Dr. Hagen twists this round in this way. "The same objectives are frequently used here with English stands and oculars, plenty of which were to be had in Paris. If, then, they did not prove themselves successful the *reason must be* that they did not attain as much as others. The circumstances of the difficulty of their adjustment is not to be allowed in this case as the reporter (Barnard) himself is an adept in their use," all of which is entirely imaginary with Dr. Hagen. A recent letter from Dr. Barnard recites the whole story. He says: "In regard to what Dr. Hagen says of my report, he so singularly misunderstands me, or so wilfully misrepresents that it seems hardly necessary to reply to him. I never said or intimated that a Tolles' stand was necessary to develop a Tolles' objective, but only that a stand of some kind was necessary, a proposition which I think stands to reason. The disadvantage could not appear until the jury, instead of examining the glasses, country by country, as I supposed they would, using certain uniform tests, ordered at once all the exhibitors of microscope objectives to present their glasses simultaneously in one place (and that, by the way, as bad a place as could be selected, a small room with one window, a moderately sized table, and no chairs). Had the first plan been pursued there would have been no trouble about stands, for Mr. Beck of London was close by the American section with a case full of apparatus, including stands of all forms, one of which he subsequently placed at my disposal for some length of time. But when the crowd came together at the place appointed, the American glasses were present without any stands, and though both Mr. Ross and Mr. Beck, *after their own glasses had been examined*, permitted me to make use of their stands, the weariness of the protracted examination, with the extreme heat of the crowded room, made the jury impatient, and notwithstanding the compliment Dr. Hagen pays me as an "adept," I was not smart enough to secure, on that occasion, what I thought a fair trial of the glasses — by which expression I mean *not* a fair development of their powers, but a fair *attention* to their development. *I never got the whole jury to examine the glasses thoroughly.* After I had obtained from Mr. Beck a stand, Dr. Brooke of London, made the fullest trial with them which I could secure from any member, and he expressed himself favorably, though he has the natural national leaning of an Englishman. It would have been ridiculous for me to narrate all this in my report, but it is absurd for any one to interpret what I do say

as Dr. Hagen does." That effectually disposes of Dr. Hagen's inferences, that the American objectives "did not attain so much as others."

Dr. Hagen attempts to controvert the opinion now unanimously received in England and America, that the microscope should be so constructed as to receive an inclination. He says, "the statement made by people here that the working with high stand instruments (they being turned back) is much more convenient, as keeping the neck straight prevents the rush of blood to the head, makes rather a comical impression. I say comical, when we consider that for tens of years back several thousand low stand instruments have been in daily use in Europe without detrimental results." [?] Possibly no one but Dr. Hagen has ever heard that the use of vertical instruments caused a rush of blood to the head; but the experience of all microscopists here (Dr. Hagen excepted), is against the use of the low stand vertical instruments, and that evils and imperfect work do result from the use of such. To show that the "comicality" of the objection is not original with American microscopists, the following is extracted from Dr. Wm. B. Carpenter's work on the microscope, — an author whose opinion is certainly equal to Dr. Hagen's thirty years experience — written fifteen years ago. "Scarcely less important * * * is the capability of being placed in either a vertical or a horizontal position, or at any angle with the horizon, without deranging the adjustments of its parts to each other," * * * * "It is certainly a matter of surprise that opticians, *especially on the continent*, should have so long neglected the very simple means which are at present commonly employed in this country of giving an inclined position to microscopes, since it is now universally acknowledged that the vertical position is, of all that can be adopted, *the very worst*." Perhaps if Carpenter's work had been translated into German fifteen years ago it might not have been needful to write this paper.

Dr. Hagen has so little to say of American microscope makers, other than Tolles, that he found it impracticable to make so many mistakes in regard to them. If he had taken more "pains" he could have added materially to the number.

Of Spencer he says: "A few years ago, however, he retired from the business." This is a mistake, for which probably Dr. Hagen is not responsible. "I have not in fact had an opportunity to compare Spencer's objectives and oculars." "In Boston, Salem, and Massachusetts generally, there are none of Spencer's instruments to be found;" that is because he "spared the pains" to find them. The writer had them, and would have guided the enquirer to others.

Of Zentmeyer he remarks: "As near as I can find out he makes no glasses. Each of his stands that I saw had objectives and oculars of Tolles or Wales." Another example of the superficial knowledge obtained by Dr. Hagen; a portion of the very oculars which he saw on Mr. Bicknell's instrument, and which he gives the power of as Tolles, were made by Zentmeyer! Had he not "spared pains" to inquire, he could

have learned that Zentmeyer does make glasses, and that one of the Tolles' stands which he had seen was furnished with an excellent objective by Zentmeyer. In the notice of Zentmeyer's stand the most important and characteristic features are entirely unnoticed!

In his notice of Grunow's instruments he particularizes an inverted microscope, the peculiarity of which was a movement by friction rollers, an invention of Tolles, and which he (Hagen) had seen various modifications of on several of Tolles' instruments, in particular the first one in which it was ever introduced; yet he failed to notice it there.

It may, perhaps, be urged for Dr. Hagen that these things are trivial, and to some they may look so; but they constitute Dr. Hagen's paper; the aggregate of the trivialities makes about the whole. Dr. Hagen fails throughout all his papers to appreciate the difference between magnifying power and quality.

With a patronizing air that is "nearly comical," after reading the paper, he compliments the artists in these words: "Messrs. Tolles and Wales are no doubt artists of the first water, constantly endeavoring to advance and enlarge their science."

Dr. Hagen admits that he has not exhausted his subject, and promises to renew it; it is to be hoped that he will, and that when he does he will spare no pains to make himself thoroughly acquainted with it; if he endeavors to do that, all our microscopists will cheerfully assist him. — C. S.

ALASKA AND ITS RESOURCES.* It is not often that an exploration is able to show such results as Mr. Dall places before the public in this volume, even when assisted by public means. We cannot, therefore, praise too highly the modest manner in which the author tells us that he was unwilling to have the plans of the former director, Major Kennicott abandoned, and therefore, undertook to carry out the remainder of the explorations which were only half completed when the telegraph company abandoned the enterprise. The author was thus left alone for one year and succeeded in completing the survey of the Yukon Valley, unassisted except by the natives. As a thorough and reliable account of Alaska, with its pictures of subarctic nature, the substantial volume before us, with its beautiful illustrations, typography, paper and binding, will claim the highest rank and retain it for years to come. We feel proud of this elegant book, and that it is the fruits of American pluck, enthusiasm, and scientific zeal.

Many of the scientific results obtained by Mr. Dall have been already published in the NATURALIST, and the great value of his discoveries in a single department of zoology, *i.e.* that of ornithology, were passed in review in the last number by an able naturalist. In reading over the plain, unvarnished, modest narrative of personal adventure and explorations in Alaska, we are struck by the earnest endeavor of the author to

* By William H. Dall. Lee and Shepard, Boston, 1870. 8vo, pp. 627. With a map and numerous illustrations. $7.50.

make his statements thoroughly reliable. Alaska is in most respects a new country,—the hand of civilized man has scarcely made its mark on the face of nature, the Indians and Innuits will soon disappear, domesticated and introduced species of animals and plants have scarcely taken up their abode and begun to wage war against the native species, and just at this juncture the record of a naturalist who has watched the changes of each season for two years in succession is a contribution of the first importance to science.

The first half (Part I) of the book is a personal narrative of travels on the Yukon River and in the Yukon territory, the first year as Director of the Scientific Corps of the Western Union Telegraphic Expedition; the second year he remained after the expedition returned, and prosecuted his explorations alone and at his own expense. The second part treats of the geography, history, inhabitants, and resources of Alaska.

In reading the narrative we occasionally meet with a paragraph of general interest to our readers. Let the author give us his first impressions of the Yukon:

"Passed over (p. 41) the flanks of some high hills, from one of which I caught my first glimpse of the great river Yukon, broad, smooth, and ice-bound. A natural impatience urged me forward, and after a smart tramp of several miles we arrived at the steep bank of the river. It was with a feeling akin to that which urged Balboa forward into the very waves of a newly discovered ocean, that I rushed by the dogs and down the steep declivity, forgetting everything else in the desire to be first on the ice, and to enjoy the magnificent prospect before me.

There lay a stretch of forty miles of this great, broad, snow-covered river, with broken fragments of ice-cakes glowing in the ruddy light of the setting sun; the low opposite shore, three miles away, seemed a mere black streak on the horizon. A few islands covered with dark evergreens were in sight above. Below, a faint purple tinged the snowy crests of far-off mountains, whose height, though not extreme, seemed greater from the low banks near me and the clear sky beyond. This was the river I had read and dreamed of, which had seemed as if shrouded in mystery, in spite of the tales of those who had seen it. On its banks live thousands who know neither its outlet nor its source, who look to it for food and even for clothing, and, recognizing its magnificence, call themselves proudly *men of the Yukon*.

Stolid indeed must he be, who surveys the broad expanse of the Missouri of the North for the first time without emotion. A little Innuit lad, who ran before the dogs and saw it for the first time, shouted at the sight, saying, amidst his expressions of astonishment, 'It is not a river, it is a sea!' and even the Indians had no word of ridicule for him, often as they had seen it."

The anthropologist will glean much valuable information from the narrative, while the second part on the manners and customs of the natives, is an important contribution to American anthropology. On page 127, in describing the Innuit casine, or town hall, it is stated that

"There is not a nail or a pin in the whole structure, which is of the most solid description. Some of the logs are two feet in diameter, and the broad seats on both sides, previously referred to, are each composed of a single plank forty-four inches wide, thirty feet long, and four inches thick. These enormous planks are from drift logs, and were hewn with the stone axes of the natives."

Of the bears, the number of North American species of which is now in dispute:

"There are three species: the large brown bear of the mountains, known as the 'grizzly' among the Hudson Bay voyagers; the barren-ground bear (*Ursus Richardsonii* of Mayne Reid), which is confined in Russian America to the extreme north-east; and the black bear,

which frequents the vicinity of the Yukon, in the woody district only. The polar or white bear is found only in the vicinity of Behring Strait, on the shores of the Arctic Ocean, and on St. Matthew's Island in Behring Sea. It has probably reached the latter locality on floating ice; we only know of its existence there from whalers, who apply the name of Bear Island to the locality, from the abundance of these animals. We know that it is not found on the mainland south of latitude sixty-five degrees. The cubs of the black bear are of the same color as the parent, and the adult is very much smaller than its brown cousin, which sometimes reaches a length of nine feet, with a girth nearly as great. The brown bear, or grizzly, is the only one which manifests any ferocity, and it always avoids any contest unless brought to bay."

Regarding the remains of the extinct elephant (*Elephas primigenius*), which are not uncommonly found on the surface, the author says:

"I picked up near the village a large portion of the skull of the extinct elephant (*Elephas primigenius*). These bones are not so common as the teeth and tusk, being found on the surface only, and usually much decayed: while the bones of the musk-ox and fossil buffalo found in the same situations are much better preserved, and sometimes retain some of the animal matter in the bone. The natives have no tradition of any other large animal than the reindeer and moose, and regard the elephant and musk-ox bones as the remains of dead 'devils.' The tusks are not so well preserved as those found in Siberia, which are usually buried in the earth. The former are blackened, split and weathered, and contain little ivory in a state fit for use, though the Innuit of the Arctic coast occasionally find them in such preservation that they make kantags or dishes of the ivory, according to Simpson."

The chapter on the geography of Alaska gives a full acount of the general topographical features of the territory, and many useful details with regard to the navigation of the shores and adjacent islands. This is a very perfect summary of all that is known of the physical history of this portion of the North Pacific, and it shows us, also, perhaps the most important result of the expedition. This was the demonstration of the cessation of the Rocky Mountains, at a point about one hundred and fifty miles south-east of Fort Yukon.

"The Rocky Mountain chain extends east of the basin of the Yukon, between it and the Mackenzie, as far north as latitude 64°. Here it bends westward, and, becoming broken, passes to the west and south, combining with the coast ranges to form the Alaskan range." This last follows the shore line to the westward, and thus the only considerable exception to the orographic law that mountain chains trend in the same direction with the coast seems to be explained, and geographers can no longer lay down the northern extension of the Rocky Mountain as reaching to the shores of the Arctic Sea. The fauna of the Yukon is almost wholly Eastern Canadian, showing that the mountains had interposed no insurpassable barrier to the north as they had to the south of the Alaskan and west of the Rocky Mountains proper.

The soil of the Yukon Valley is always frozen at the depth of three or four feet, and in some cold situations remains icy near the surface. "This layer of frozen soil is six or eight feet thick." "This phenomenon appears to be directly traceable to the want of drainage, combined with the non-conductive covering of moss," which prevents thawing in the summer heats. Nevertheless this frozen soil has "a healthy and luxuriant vegetation, bearing its blossoms and maturing its seeds as readily as in situations apparently much more favored."

But next in value to the geographical details are the many authentic

facts regarding the natives now so rapidly disappearing. By learning to speak their language, and living among them, his testimony is of special value, and he says that he was enabled to correct many erroneous impressions formed early in his visit to the country, by more careful and repeated observations and knowledge of their language. Of the Esquimo he made a special study, and cautiously remarks (on p. 154) that "it is impossible to doubt that among all American aborigines, much in their mode of life, customs, and ceremonials is of a local nature, and due to extraneous circumstances. Much is also due, unquestionably, to the similarity of thought and habit which must obtain among human beings of a low type, and who gain their living by similar means. Hence, a general similarity of many customs may naturally be expected between both Innuit and Indians, as well as for distant aborigines of different parts of the world, and this similarity can afford no basis for generalizations in regard to their origin."

As regards their affinities, he writes: "It should be thoroughly and definitely understood, in the first place, that they are not Indians; nor have they any known relation, physically, physiologically, or otherwise, to the Indian tribes of North America. Their grammar, appearance, habits, and even their anatomy, especially in the form of the skull, separate them widely from the Indian race. On the other hand, it is almost equally questionable whether they are even distinctly related to the Chukchees and other probable Mongolian races of the eastern part of Siberia" (p. 137). As to the origin of the word Eskimo we are told that "the Indians call the Innuit and Eskimo *Uskeémi*, or sorcerers. *Kaguskeémi* is the Innuit name for the Casines, in which their Shamáns perform their superstitious rites. From this root comes the word Eskimo."

In the chapter on the aboriginal inhabitants of Alaska, he begins by dividing the inhabitants into Indians and *Orarians*, the latter embracing the tribes of Innuit, Aleutians and Asiatic Eskimo. The author is inclined to reject the theory most in vogue that America has been peopled from Asia or Polynesia, and "proposes to attempt to show that so many of the facts which have been used in support of this hypothesis are susceptible of quite another interpretation. I refer to the existence of tribes of Orarian stock on the coast of the Chukchee Peninsula," which were originally derived from America, their emigration having taken place within three hundred years. He adds beyond that "there is no doubt but that the Aleutians originally emigrated to the islands from the American continent, driven by hostile tribes. The Innuit formerly extended farther south than they do now, and in this connection we find the suggestive remark that "Dr. Otis, of the United States Army Medical Museum at Washington, who has handled as many aboriginal American crania as any northern ethnologist, says that the skulls found in the northern mounds have the same peculiarities which distinguish all Orarian crania, and that both are instantly distinguishable from any Indian skulls."

The chapters on the climate and agricultural capabilities and geology,

and the whole tenor of the remarks on this subject leads the reader to the belief that the purchase of Alaska was wisely made by our government.

TROUT CULTURE.*—This is just the book that has been wanted by every one interested in the raising of fish by artificial propagation. It contains a statement of the experience of the most successful fish breeder in the country, presented in concise and forcible language; every word fully convincing the reader that the author is simply giving the results of his experience, with the earnest desire of furnishing others with all the information necessary for them to become as successful breeders of trout as himself. With this book in hand, and a proper location and supply of water, there is no reason why trout raising should not succeed in the hands of any careful and energetic person. In fact nothing but pure carelessness could make it fail, though, like all other stock raising operations there are many things that should be looked after before the eggs are placed in the hatching house; and as no sheep raiser would purchase five hundred sheep for his farm unless he had what he knew to be sufficient past rage for so large a number, so no trout raiser should purchase his five hundred or more trout eggs unless he has plenty of good water. We have not space for the extended review of this little work which our interest in the subject would otherwise lead us to make, and can only say that every point is fairly and plainly presented, from the location of the pond, its best depth and shape, its bottom, its screens and water supply; to the transportation of eggs and live fish; and all the intermediate operations of procuring the eggs in different ways, the construction of the hatching house, handling the eggs and young fish; with observations on their diseases and enemies; careful statements regarding the amount of water required for each fish of different ages, etc., etc. In fact every information that long continued and successful operations enables the author to feel confident is just what beginners want, is here given. An improved spawning screen, invented by Mr. Collins (Mr. Green's partner), is described and figured. This screen or box is so designed as to secure the eggs of trout and other fishes that have been spawned in a natural way, and is a most convenient and labor saving contrivance for the trout breeder. We hope to give a communication on this subject in a future number.

There are several facts very interesting to the naturalist alluded to by Mr. Green. The average age of a trout he thinks to be about twelve or fourteen years, and that trout are in their prime during the age of from three to ten years. Mr. Green also states that trout will *not* live in water the temperature of which is above 68°, and do best at a temperature of 48°.

On the last page of the book Mr. Green calls attention to a "worm"

* *Trout Culture.* By Seth Green. 12mo pamph., pp. 92. Green and Collins, Caledonia, New York. [For sale at the Naturalists' Agency, Salem. Price $1.00.]

which is very destructive to young trout and other fish, by catching them in webs which are spun under water.

"The web is as perfect as that of the spider, and as much mechanical ingenuity is displayed in its construction. It is made as quickly and in the same way as a spider's, by fastening the threads at different points and going back and forth until the web is finished. The threads are not strong enough to hold the young trout after the umbilical sac is absorbed, but the web will stick to the fins and get wound around the head and gills and soon kills the fish."

This "worm" is, according to an article in the June number of the "American Entomologist and Botanist," the larva of the notorious Black-fly, or at least of a species of the same genus, *Simulium*, and is figured in the "Entomologist," where also there is an important article on the transformations of this pest to fishermen, and as it now turns out to fishes also.

Messrs. Green and Collins are ready to supply persons with trout eggs at $10 for a single thousand, or young trout at $30 a thousand, to any extent required, from their farm at Caledonia, and as both eggs and young can be, and have been, sent in perfect safety to various parts of the country, and even to France and England, there is now no reason why every northern stream should not have its supply of "spotted beauties."

Record of American Entomology for 1869.*—After a greater delay than was anticipated this "Record" has at length appeared. The editor states in the introductory that "the number of American entomologists whose articles or notes are referred to in the "Record" is fifty-two; while three hundred and thirty-five new species of North and Central American insects have been described in American journals during the year 1869." We are glad to notice that our American entomological literature has assumed a highly practical character, and comprises much regarding the habits of insects, a never failing source of interest. The remarks by Baron Osten Sacken should be carefully read by every entomologist, especially the beginner, and are well worth the price of the whole pamphlet.

Brazilian Crustacea.†—In this carefully prepared essay Mr. Smith remarks that "the collection, although quite small in number of specimens and representing only the higher groups of the class, is interesting from the large proportion which it contains of species heretofore known only from the West Indies or Florida. This is, perhaps, due chiefly to the fact that most of the collections brought from Brazil have been made at Rio Janeiro, where there are no coral reefs, while Professor Hartt's collection was made principally on the rocky and reef-bearing parts of the coast." Five new species are described, and a new genus, *Xiphopeneus* (*X. Hartii*). The plate is lithographed from photographs and is of unusual excellence.

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* For sale by the Naturalist's Book Agency, Salem. July, 1870. 8vo, pp. 62. Price $1.00.

† Notice of the Crustacea collected by Professor C. F. Hartt on the coast of Brazil in 1867, together with a List of the described species of Brazilian Podophthalmia. By Sidney I. Smith. (From the Transactions of the Connecticut Academy of Arts and Sciences. Vol. 2, 1870. 8vo, pp. 41.)

THE POPULATION OF AN OLD PEAR TREE.*—The author in these charming stories of insect life relates his experience with various forms of insects which visited an old pear tree in his garden, weaving in many satires on human life, and an occasional sly thrust at professional entomologists who look on bugs simply as bugs and not as part and parcel of nature. It is an admirable book to place in the hands of boys and girls. The illustrations are capital, reminding us of the grotesqueness and strong effects seen in Doré's drawings on wood, and form a marked feature and attraction of the book.

THE AMERICAN MUSEUM OF NATURAL HISTORY.†—Under this title there has been established in the city of New York a museum in whose list of trustees we recognize many names well known to the citizens of the metropolis. While we honor these gentlemen for their public spirit we do not see even from their report how it was that they thus suddenly became possessed of such a determined desire to found a museum.

We believe that New York will eventually possess the finest and largest museum in the country, just as they now have the most beautiful park. There is, however, one mistake which we might notice, the futility of amassing fragile collections, building cases, having zoological gardens, etc., without at the same time appointing men who are competent to use them for the benefit of the public. From what we have seen of the efforts of the directors, or whoever has in charge the large collections in the third story of the arsenal building, we should say that they do not seem to possess even that slight knowledge which five minutes criticism from any competent scientific man would have given them. We have never in our experience of the unscientific attempts to build museums seen anything so entirely unfit for its purpose as the large two-storied case which occupies the centre of the arsenal hall. No one but a physician, or a committee of such, well acquainted with hospital practice and hygiene, would presume to attempt the erection of a hospital. Engineers are generally called upon to build railroads and steam engines, but in natural history all this is reversed, and we do not seem to have yet learned that it requires a naturalist to plan a natural history building. We understand, however, that efforts are being made to place some well qualified naturalists in charge of the executive department, and we hope to see a change in this respect before the next report is published.‡

The menagarie will afford materials for the formation of a collection of comparative anatomy which would be both amusing and instructive to visitors, but this does not seem to have been thought of. The board of management, also, appear to be drifting to stuffed skins of birds and

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*The Population of an old Pear Tree: or Stories of Insect Life. From the French of E. van Bruyssel. Edited by the author of the "Heir of Redclyffe." With numerous illustrations by Becker. 12mo, pp. 221. New York. Macmillan & Co. 1870.

†First Report of the Trustees.

‡Since the above was written, we have become aware, also, that the Commissioners have taken professional advice as regards the construction of their cases.

mammals. The accumulation of the latter would most certainly be of great benefit, but a large collection of the former would simply duplicate the museums of Philadelphia and Boston.

Our strictures are wholly due to a desire to awaken the directors of this museum to the importance of avoiding the errors of their predecessors. There is no reasonable excuse for a board of management which, at the present day, repeats the mistakes which have characterized the past history of all the museums with which we are acquainted, either in this country or Europe. We recommend especially to their perusal a short article upon the "Scientific Institutions of North America," by George Bentham in his Annual Address to the Linnæan Society, for 1867, and the various articles frequently published upon the proper management of museums and kindred topics in "Scientific Opinion" and "Nature."

Efforts are, however, being made to change this state of affairs, and we hope to report in our next notice that the American Museum is, in all respects, worthy of the name that it has taken, and of the city that should have a museum unequalled by any in the country.

NATURAL HISTORY MISCELLANY.

BOTANY.

FRAGARIA GILLMANI. — In a note on this plant by Mr. Gillman, page 312, it is stated that Dr. Asa Gray considers that the "well developed leaf on the scape, proves to be the distinguishing character of the species." It is not clear whether this refers to *F.* "*Mexicana*," or *F.* "*Gillmani*;" but to show that neither can lay claim to this character exclusively I enclose a leaf of *F. vesca*, in which are not only well developed leaves on the scape, but better developed leaves than I have yet seen on *F.* "*Gillmani*."

In my note on *F.* "*Gillmani*" last year I stated that leaves on the scape, or flowers on the runners were poor characters to found species on, because a flower scape is nothing but an erect runner, and a runner but a viviparous scape. In this specimen, now sent, you will see this illustrated by the *rudiments of roots*, as well as leaves on the scape. — THOMAS MEEHAN.

[We understand Dr. Gray to have remarked that all the specimens he has seen of Schlechtendal's *F. Mexicana* have leaf-bearing scapes, and that *F. Gillmani* is the same thing; and that he has no decided conviction as to whether it be the European *F. vesca* which has assumed this condition and habit in Mexico, or an aboriginal form, — which in either case is curious. — EDS.]

NEW PLANTS. — In my botanical rambles this last May two new plants came under my own observation. One of them which we have made known as *Viola erecta*, was found near Williamstown, Mass., and is a variety of *V. Selkirkii*, differing from that species in its larger size and in its leaves being strictly erect and not lying flat upon the ground. The other which was discovered at Binghamton, N. Y., and called by us *Geranium album*, has a white flower with yellow anthers and leaves, but little hirsute characteristics which mark it as a distinct variety of *G. maculatum*. — H. M. MYERS, *Williamstown, Mass.*

PALMS OF THE SANDWICH ISLANDS. — In the interesting popular account of palms, contributed by Dr. Seemann to the "Gardener's Chronicle," it is mentioned that three species of *Pritchardia* are known from these islands, namely, *P. Martii* and *P. Gaudichaudii* (briefly noticed by Martius under the name of *Livistonia*, from very imperfect materials furnished by Gaudichaud), "and an undescribed species enumerated by Horace Mann." It is farther noted that none of these species are yet introduced into cultivation. There is, however, no evidence to show that the palm noticed by the late Mr. Mann is different from one or the other, not to say both, of Gaudichaud's; and it is here well known that Mr. Mann brought a stock of seed of his palm, from which numerous young plants were raised both in this country and at Kew. Of these the best developed specimen known belongs to the collection of H. H. Hunnewell, of Wellesley, Mass.

THE IRRITABILITY OF THE STAMENS IN THE BARBERRY, according to Jourdain ("Comptes Rendus" April 25th), is suspended by chloroform. A bit of cotton sprinkled with chloroform, and introduced into the *glass* bell-glass which covered the plant operated on, produced tetanic rigidity of the filaments in one minute; but exposure to the air soon restored the irritability, unless the action of the chloroform had been continued ten or twelve minutes, in which case the vitality of the flowers was greatly impaired or destroyed. — *Academy.*

ZOOLOGY.

THE FUTURE OF NATURAL SCIENCE. — We had heard it stated that henceforth physical discovery would be made solely by the aid of mathematics; that we had our data, and need only to work deductively. Statements of a similar character crop out from time to time in our day. They arise from an imperfect acquaintance with the nature, present condition, and prospective vastness of the field of physical inquiry. The upshot of natural science will doubtless be to bring all physical phenomena under the dominion of mechanical laws; to give them, in other words, mathematical expression. But our approach to this result is asymtotic; and for ages to come — possibly for all the ages of the human race — nature will find room for both the philosophical experimenter and the mathematician. — *Tyndall's notice of the "Life and Letters of Faraday" in the Academy.*

THE PIGEON HAWK. — Mr. Samuels, in his work on the "Ornithology and Oology of New England," says that he never saw a nest of this bird, and never heard of but one instance of its being found in New England, but he adds that it doubtless breeds here. This may be true, but it seems to me almost as though he really could not have inquired into the matter, for in this very town (Amherst, Mass.), I know of three positive instances of the nest being found; they all were in holes of trees; in two there were four eggs, and in the other five; the last mentioned one was discovered this year; there can be no doubt as to the identity of the eggs, so I do not hesitate to show this fact. The bird seems to be comparatively common here. It seems to me as if this bird is so often here, and found to breed here, it must be that some other town or state in New England receives its due share of attention. — WINFRID STEARNS, *Amherst, Mass.*

THE FLIGHT OF BIRDS AND INSECTS. — M. Marey has recently shown that birds and insects fly in a totally different manner. In birds the extremity of the wing describes a simple helix, while in insects it passes through a series of lemnisces (lemniscates, or figures of eight). The author has studied this intricate subject by means of two very ingenious machines, one of which, by a very simple arrangement, indicates very precisely the flight of an insect; while the other made to be placed on the back of a bird, transmits all the movements of the wing to a receiver which faithfully records them. — *Cosmos.*

PÆDOGENESIS IN THE STYLOPIDÆ. — Professor von Siebold has discovered that the so-called female of Xenos is in reality a larva, and that it produces its young by germ balls like those of the larva of Cecidomyia (Miastor) which produces larvæ like itself during the winter months, but in summer undergoes the usual transformations of these gall flies. This child-reproduction, in individuals without true ovaries, was aptly termed by Von Baer "Pædogenesis."—*Siebold and Kölliker's Journal of Scientific Zoology.*

CURIOUS CONDUCT OF A SHARP-SHINNED HAWK. — On the 6th of April, while wandering along the Shabbaconk Creek, near Trenton, N. J., I sat down on a convenient mat of dead grass to observe the movements of the "red-fins" (*Hypsilepis cornutus*), swimming in the clear waters before me, and to note also, the movements and colors of some "darters" (*Hololepis erochrous* Cope) that I had caught and bottled. While thus engaged my attention was called to the great tameness of a small hawk (*Accipiter fuscus*). It had evidently been visiting the grass, on which I was now sitting, gathering from it materials for lining a nest which I soon discovered near the top of a high beech tree, not fifty yards distant. When the bird found that I was not disposed to move off, he skimmed away over the meadow and perched upon the fence skirting it. Presently he sailed towards me near the ground and lit by a small tuft of grass. Walking around this he scratched the ground away from the roots, and then seiz-

ing the tuft with one claw, dragged the roots up, and shook off the adherent earth, very much as a man would pull and shake a radish or turnip. Not content with this the hawk now laid the grass upon the ground, combed it out with his beak, and then gathering it up in his bill, flew to the neighboring fence, and hopped along until it found a rail with a narrow crotch in the end. In this it placed the grass, so that the expanded bunch of roots should be on one side and the blades of grass on the other of the notch. When thus arranged to the bird's satisfaction, it again took up the grass in its beak, and giving it a sudden jerk broke the roots from the blades. It then flew to its nest. — CHARLES C. ABBOTT, M. D.

PARTHENOGENESIS IN A WASP. — Professor von Siebold has discovered that in *Polistes Gallica* the males are developed by parthenogenesis, from unfertilized eggs. It will be remembered that in the honey bee the drones are also developed from unfertilized eggs laid by the queen. — *Siebold and Kölliker's Journal of Scientific Zoology.*

LIST OF NEW ENGLAND LEPIDOPTERA. — Mr. S. H. Scudder has published a very valuable and complete list of the butterflies found in New England. I propose to prepare for publication a similar list of the larger Heterocera (Sphingidæ to Phalænidæ inclusive). Any information relating to the times of the appearance of the imagines, or to the food plants of the larva, would be particularly acceptable. Notices, also, of the captures of rare moths or those not strictly part of the New England fauna, and lists of the species taken in any one locality, would afford most important assistance. It would be a great convenience if any one wishing to aid me would communicate any facts to me as early as possible. — CHARLES S. MINOT, 39 *Court Street, Boston.*

IMPROVING INTELLIGENCE IN BIRDS AND INSECTS. — M. Pouchet, the Director of the Museum at Rouen, and a well known naturalist, "has discovered that the new school of swallows are improving their style of architecture, building their nests with more regard to sanitary principles, so as to contain more room and admit more light and air. The shape of the nest is, we infer, more nearly that which will include a maximum of inhabitable space; and, besides this, and still more important, the entrance to it has been changed from a small round hole into a long slit, a sort of balcony, from which the young swallow may look out upon the world and breathe fresh air. What is more, the new school of swallow architects appear to prefer the new streets, while the old school still build the old nests on the cathedrals and older houses; perhaps from some sense of artistic fitness, which scruples at any change of style in adding extensions to monuments so venerable. If this last fact could be satisfactorily established it would furnish a complete answer to the Darwinian theory, so far as it dispenses with intellectual motives for animal progress, and would show a curious amount of æsthetic culture. No doubt migrating birds are of all others least likely to be the slaves of

local prejudices. As the travelled cuckoo was the first to conceive the idea of putting her children out to school among strangers, so the swallow, no doubt, has learned in the south, where air and prospect and space are best appreciated, to adopt the verandah principle, there so universal. Both bees and birds have now been shown to have made great strides in architectural knowledge." "London Spectator," April 16, 1870, in a communication from "Pouchet" in the "Pall Mall Gazette."

A parallel instance in bees is noticed by Dr. Ogle in a very important article on the "Fertilization of Various Flowers by Insects," contributed to the April number of the "Popular Science Review." The arrangements for the cross-fertilization of the flowers of the bean and other papilionaceous plants by bees, here described by Dr. Ogle, are pretty well known, as also the fact that both humble and hive bees have the trick of evading their duty by piercing a hole in the side of the calyx of bean-flowers, so getting at the nectar by a short cut. Dr. Ogle has remarked that while some bees visit the blossom in the natural way, and in so doing take pollen from the anthers of one flower to the stigma of the next, others avail themselves of the shorter cut; but that an individual bee, visiting a succession of bean flowers, uniformly does either the one or the other. It would thus appear that the habit is not an instinct, belonging by inheritance to the whole species, but is in each case the result of individual experience. As with the same experience some bees have acquired the habit and others have not, we must admit, not only that these insects are intelligent, but that they differ from each other in their degrees of intelligence; some being slow in acquiring knowledge, others quicker. The Scarlet Runner, when the bloom is covered with gauze to keep off insects, is wholly sterile; and so indeed habitually are a good many of the uncovered blossoms. The latter is probably owing to the observed fact that most bees have learned to get at the nectary by nipping the tube. Were all bees equally clever there would be an end of scarlet runners, unless indeed either nature or artifice were to induce some modification of structure by which the tube might be protected and the bees again driven to the mouth." We think it proper to add that Dr. Ogle's interesting article is sadly marred and obscured by gross errors of the press, showing that the proofs have not been revised by the author nor by any competent proof reader.

How many Lepidoptera are there in the World? — This question is thus answered by Mr. Bates in his able address to the Entomological Society: — In the "Stettiner Entomologische Zeitung" I find a very readable paper by Peter Maassen, of Elberfield, on a subject which will be interesting to most entomologists. It is an attempt to compute the total number of species of Lepidopterous insects existing in nature, and is written in correction of a previous crude essay by Keferstein on the same subject. In his estimate the author takes for his basis the curious fact that in all complete lists of local Lepidopterous faunas in Europe the

number of moths to butterflies is as twenty-six to one. He then gets at the probable number of butterflies in existence, by arguing from the number published, districts unexplored, and so forth, and believes the number to be not fewer than eight thousand seven hundred and forty. Unfortunately, in pursuing the calculation he forgets his datum-line of twenty-six moths to one butterfly, and takes the proportion as it stands in Staudinger and Wocke's "Catalogue of European Species," where the proportion of course is much less, because the smaller moths have not been so exhaustively collected throughout Europe as the butterflies. In this way he arrives at the total number existing in the world as one hundred and twenty-nine thousand seven hundred and forty — a surprising amount, but still far below the truth if the proportion found in well-worked districts in Western Europe is maintained throughout the world, which would produce the incredible total of two hundred and twenty-seven thousand two hundred and forty species.— *Scientific Opinion.*

Oological. — Two years ago while down here some friends of mine took three eggs from the nest of a red bird (*Cardinalis Virginianus*), and put in their place a Guinea hen's egg. The old bird sat upon the latter about three weeks, and then left. In numbers of nests of this bird found in this state and in Pennsylvania, the number of eggs in the former were invariably three, and in the latter four. Can any one explain this constant difference in the number of eggs? — C. H. Nauman, *Smyrna, Florida.*

Spike-horned Deer. — With regard to the question in discussion between W. J. Hays and Adirondack, whether spike-bucks ever are more than two years old, will you accept the "opinion" of one who has had some experience among deer at the other extremity of our country?

I know nothing of the Adirondack region, personally. I fancy however, it is of small extent: and I suppose it is surrounded by a settled country, peopled for a century or more by a less or greater number of skilled hunters.

Is Adirondack prepared to affirm, without a shadow of doubt, or can he prove to one tinctured with incredulity, that the region actually contains a buck five or six years old? He thinks it easy to distinguish a buck of "full age and size," though destitute of antlers, but gives no marks by which another can judge of the age. I would like to know how he would decide between a remarkably well grown buck of two years, and a runty one of three or four years, in the absence of horns. Among domestic animals may often be seen thrifty yearlings, which will outweigh starvelings of two years or more.

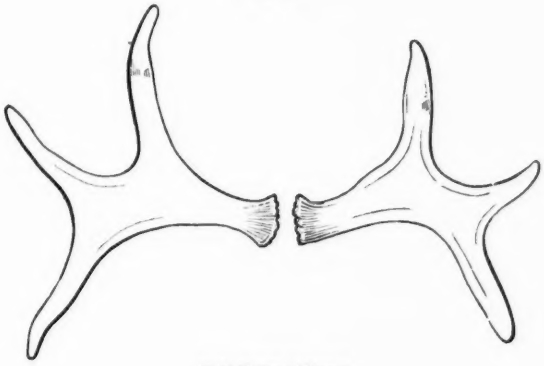
I have killed my hundreds of deer, perhaps — never one spike-buck that would not have been pronounced young by competent judges. I lived with an old hunter who had probably slain his thousands. I never heard him speak of an old buck with unbranched antlers. In my days of deer hunting I associated with many other men more or less acquainted with deer, from none of whom did I ever hear of an *old* spike-horn buck. Can

Adirondack cite from any park an example of such a one whose age is known with certainty? This would be to the purpose.

The explanation given by Mr. Hays seems to be a satisfactory one. The idea that a new race of deer has appeared in that small district within the last few years out-Darwins Darwin. — CHARLES WRIGHT.

A SPIKE-HORNED MOOSE. — Several instances of the capture of "spike-horned" bucks of the common deer (*Cervus Virginianus*), having been recently reported in the NATURALIST (Vol. III, p. 552, Dec., 1869; Vol. IV, p. 188, May, 1870), interest has hence been awakened in respect to this unusual condition of the antlers in the Cervidæ. A "spike-horned" moose, captured in Northern Maine by Mr. J. G. Rich, was recently received at the Museum of Comparative Zoology, of which the accompany-

Fig. 93.



Spike Horns of Moose.

ing figure (Fig. 93) correctly represents the form of the horns, as seen from the front. Mr. Rich writes me that full-grown moose having horns of this character are well-known to the moose hunters of Maine, by whom such animals are termed "spike-horns." Mr. Rich states this animal to have been six or seven years old. Though not a large specimen it was evidently a full-grown one. He says it is believed by the hunters that these animals never shed their horns. The present specimen was taken late in March, nearly two months after the time when these animals usually cast their horns. — J. A. ALLEN.

A NEW INSECT PARASITE OF THE BEAVER. — Herr Krisch has discovered a parasite of the European beaver, which unites the flattened body of the lice, with the peculiarities of the fleas. By the presence of rudimentary wings it is nearest allied to the Diptera, and is named *Platyspyllus castoris*. — *Proceedings of the Natural History Society Isis, in Dresden.*

GEOLOGY.

Ancient Reptiles of the Connecticut Valley. — Professor Cope has noticed in the "American Journal of Science," the bones of the *Megadactylus polyzelus* of Hitchcock found at Springfield, Mass., and infers that they "demonstrate the former existence in the region in question, of a typical form of the suborder, or order *Symphypoda*, and one nearer the birds than any other hitherto found in America." "That animals of this genus made some of the tracks similar to those of birds in the red sandstones of the valley of the Connecticut there can be no doubt," and the author adds that there is abundant reason that they progressed by leaps.

The Rate of Geological Change. — Mr. H. M. Jenkins writes on the rate of geological change, in the "Quarterly Journal of Science," and comes to the conclusion that

> "Whether we measure the relative lapse of time occupied by the successive events of geological history by the known facts of the accumulation of deposits, or by the comparative changes which have occurred in the life of successive periods, we are led equally to infer that the *rate of geological change* has been more rapid in the latter than in the earlier geological periods, and that that rate has increased progressively from the earliest to the latest times."

MICROSCOPY.

Air-tight Specimens. — When shall we cease to suffer from the directions sometimes given to mount dry specimens in a cell of pasteboard or paper, fastening the glass cover down by "a little gum" or "paste?" Of course dust or moisture soon accumulates in the cells, or fungoid vegetation grows until it becomes a beautiful and conspicuous specimen; but in any case the original object is tolerably certain to be marred or ruined. I not unfrequently see collections of specimens, by popular makers, which have perished in this manner. Lately I lost in this way a very choice specimen prepared by one of the best European makers, whose work is usually faultless; and still later, having occasion to remount a group of diatoms which had been bought at a considerable price, I found the thin glass-cover supported at its four corners by little pieces of pasteboard, and fastened down by pasting over its edges the handsome paper cover of the slide. I have not yet seen any of Bicknell's beautiful specimens prepared in this slovenly manner, but scarcely any maker seems to be entirely exempt. I know of no cure for this state of things except for microscopists to refuse to buy any specimens, except those mounted in balsam, which are on paper-covered slides. Working microscopists can, and often do, preserve dry objects in cells of paper and pasteboard, an arrangement which is both convenient and economical; but such preparations should always be carefully protected by Brunswick black or some other impervious varnish. — R. H. W.

THE FOCAL LENGTH OF MICROSCOPIC OBJECTIVES. — Mr. C. R. Cross has ably discussed this subject in the "Franklin Journal." He remarks: "The investigation of which the present article is a summary, was undertaken in order to see if some reliable method of measuring the focal length of microscope objectives could not be found. The importance of such a method will be apparent to all who have had occasion to make use of objectives by different makers. The focal length of lenses of the same denomination is subject to so great a variation that comparison of these by means of their assumed focal lengths too often gives no true idea of their relative excellence. For example, if two quarter-inch objectives be compared, and one gives results much superior to that given by the other, we cannot be at all sure that the better lens is not really of shorter focus than its designation would indicate." He presents a table giving "the results of several hundred measurements on various objectives, and suggests that an examination of the table will show that the focal length of the objectives of some makers differs considerably from the length marked upon them. For example, No. 34 marked 1-2 inch is really a 1-3 inch objective; No. 33 marked 1-4 inch is really a 1-5 inch; No. 29 marked 4-10 inch is really a 1-4. Lens No. 14, marked 1-4 inch, is really a 1-5 inch; but Nos. 13, 15, by the same makers, are correctly designated 1-5 inch, 2-3 inch. Differences of this kind must of necessity lead to a great confusion in comparing objectives with one another. I would therefore suggest that each objective made should be measured before being offered for sale, that this confusion may cease to exist. A convenient arrangement would be to fix a glass scale divided to 1-50 or 1-100 inch in the draw-tube, sliding in the tube of the microscope, and measure as I have already described. The draw-tube should be moved till the front of the ruled glass shall be exactly 10 inches from the micrometer used as the object. Or it would be more convenient still to have an apparatus similar to the first form, but arranged with a suitable stage and stand so that it can be set at any desired angle. The distance 10 inches (254mm.), suggested as a standard is chosen because it is the normal distance of distinct vision, as well as about the length used by microscopists in actual work."

ANTHROPOLOGY.

PERUVIAN ARCHÆOLOGY. — The extent to which the conditions of mankind are influenced by natural circumstances, and how these may dictate, not alone the architecture and arts of a people, but their social, religious and political organizations, is perhaps nowhere better illustrated than in Peru. The Inca Empire, it seems to me, was only rendered possible by the peculiar geographical and topographical position occupied by the family or families that were its founders. Long antedating that empire its vast area contained a great number of communities, tribes, or principalities, more or less advanced or civilized, separated from each other,

however, on the coast, by hot and almost impassable deserts, and in the interior by lofty mountains, or cold and trackless *punas*. They had but little intercourse or political dependence, and they all, when by means of alliance or conquest the enterprising families around Cuzco became consolidated, fell an easy prey to those inhabitants of the high, strong fastnesses, or *bolsones*, of the Andes. From their dominating position the Incas were enabled to throw overwhelming forces successively on the isolated valleys radiating from their mountain centre, and one by one mold them into the grandest of aboriginal American Empires. It is easy to see how ambition, and the exigences arising out of their aggressions, should have developed gradually that astute policy or statesmanship, that ability in organization and administration, of which the Incas furnished such a remarkable example.

That portion of the Andean plateau lying between the Pass of La Raya, at the northern extremity of the Titicaca basin and the Pass of la Banda, near Pasco, is a great mountain-encircled region, drained by the River Ucayali, itself, as we have seen, formed by the Vilcamayo, Apurimac, and Pampas flowing north, and the Mantaro flowing south. The beds of these streams are deep and narrow, being merely gigantic canals or drains for the waters collected in numberless vales among the mountains. Nothing better describes these vales than the Spanish word *bolson*, or pocket. And, as I have said, while the valleys of the coast are separated by deserts, these *bolsones* are isolated by ranges of hills, mountains, or uninhabitable *punas*, and all these are divided into groups by the great rivers, which, like the Apurimac, are intransitable except by the aid of bridges of *mimbres*, or ropes swinging dizzily in mid-air.

These *bolsones* are of varying altitudes and consequently of various climates and productions. Some are well-drained, others are marshy, and contain considerable lakes. They discharge their gathered waters, often in large streams that plunge, in numberless cataracts, through dark and narrow ravines into the gorges of the great rivers. The passage from one *bolson* to another is over the intervening elevated ridges and *punas*, frequently among frost and snow, and always by rocky and difficult paths, fit only for the goat and the llama.

It was in precisely one of these *bolsones*, the central one of a group or cluster lying between the Vilcamayo River and the Apurimac, that the Incas built their capital. It is not only central in position, salubrious and productive, but the mountain barriers that separate it from its neighbors are relatively low, and subside into passes that may be traversed with comparative ease, while they are at the same time readily defensible. The rule of the first Inca does not seem to have extended beyond this valley, and the passes leading into it are strongly fortified, with works that face outward, indicating the directions whence attack was possible in the early days of the empire, before the chiefs of Cuzco commenced their career of conquest by reducing the people of the *bolson* of Anta or Xaxiguana on the north, and of Urcos or Andahuaylillas on the south.

The *bolson* of Cuzco, which is not far from thirty miles long, is divided into two nearly equal parts by the Pass of Angostura, or the narrows, where the mountain spurs project toward each other into the valley, leaving hardly room enough for the roadway and the river. On the promontories dominating this narrow passage are the conspicuous ruins of many buildings and remains of works, showing that this was regarded as a strategic or important position, for the immediate protection of the capitol.

The City of Cuzco, which occupies the site of the ancient capitol, stands at the northern or most elevated extremity of the *bolson*, or valley, on the lower slopes of three high hills, the Carmenca, Sacsahuaman, and Cantuta, where as many rivulets, the Almodena, Huatenay and Tullamayo, or Rodadero, coming together like the fingers of an outspread hand, unite to form the Cachamayo, which drains the valley, and falls into the Urubamba. The old city, or rather that part of it dedicated to the royal family, was built on the tongue of land falling off from the hill or headland of the Sacsahuaman, between the Huatenay and the Rodadero.

The position of this city, as determined by Mr. Pentland, is latitude 13° 31′ S., and longitude 72° 2′ W. of Greenwich. Its elevation above the sea, eleven thousand three hundred and eighty feet. Surrounded by high and snowy mountains, it might be supposed to have a cold, not to say frigid climate, but in fact its temperature, though cold, is seldom freezing, and although in the dry season, or what is called winter, from May to November, the pastures and fields are sere, and the leaves fall from all but queñua trees, yet all this is rather from drouth than frost. On the whole the climate is equable and salubrious. Wheat, barley, maize, and potatoes ripen in the valley, and the strawberry, apricot, and peach are not unknown. The climate of Nismes, and of the south of France generally, is much the same with that of Cuzco. When we add to these favorable conditions that not more than thirty miles distant are deep, hot valleys, where semi-tropical fruits may be produced abundantly, we may comprehend that Cuzco was not an unfavorable site for a great capitol.

Its geographical position as regards the country at large, as I have said, was also such as to make it a citadel and the dominating centre of an empire. Its very name, if we may credit the chronicler, signified *Umbilicus*. The Inca power once fairly established in the cluster of valleys, of which I have spoken, and the few and narrow passes by which only they can be reached, strongly fortified, as they were, it was comparatively easy, as I have already said, for the Incas to overwhelm the inhabitants of the long and narrow valleys running down the slopes of the Andes and the Cordilleras, and to subdue one by one the families dwelling in the *bolsones* northward to the Equator, and southward below the desert of Atucama — over an extent of thirty-seven degrees of latitude. — E. G. Squier, *from Lecture on Peruvian Archæology delivered before the American Geographical and Statistical Society, February* 15.

ANSWERS TO CORRESPONDENTS.

E. S. Miller. Your specimens reached us in such a decayed condition that it was difficult to recognize them, and after careful study we made out the species as follows: No. 1, *Pontederia cordata*; No. 5, *Ranunculus*, perhaps *R. parviflorus*, but the specimen was insufficient; No. 6, *Lobelia spicata*; No. —, a coarse plant, and is *Lithospermum*; No. —, *Hypericum mutilum*; No. —, *Gratiola aurea*; No. —, *Schollera graminea*. Specimens of plants should be carefully pressed and dried, and never sent fresh, unless intended for cultivation. The deficient numbers were of tickets either destroyed by the heat or fermentation, or torn accidentally on opening the package. We do not want any of the kinds sent as they are common hereabouts, though we thank you for your offer. — J. L. R.

BOOKS RECEIVED.

Proceedings of the Acad. of Nat. Sciences. Phil. January, February, March and April, 1870.
Third Annual Report of the Provost of the Peabody Institute to the Trustees. Baltimore, 1870.
Annual Address of the President of the Worcester Lyceum and Nat. History Association. 1870.
Geology of Vermilion Co., Ind. By Prof. F. H. Bradley. (From Geol. Report of Ind.). 1870.
Commelinaceæ Indicæ Imprimis Archipelagi Indici. Auctore C. Hasskarl. 8vo, 1870.
The Woody Plants of North Carolina. By M. A. Curtis, DD. 8vo. Raleigh, 1870.
Geological and Natural History Survey of North Carolina. Part 3. Botany. By M. A. Curtis, DD. 8vo. Raleigh, 1867.
Trout Culture. By Seth Green, Rochester, 1870.
The Academy. No. 9. June, 1870.
Annual Report of the Trustees of the Museum of Comparative Zoology for 1869.
Thirty-three Ornithological pamphlets. By Geo. N. Lawrence.
Fifty-second Annual Report of the Trustees of the N. Y. State Library. Albany, 1870.
Cranberry Culture. By Jos. J. White.
Glimpses of Nature. S. M. Maxwell.
Chemist and Druggist. London, July 1, 15, 1870.
Verhandlungen der K. K. zoologisch botanischen Gesellschaft in Wien. Band, xviii, 1868, xix, 1869. 2 vols. 8vo.
Zeitschrift fur Akklimatisation. 1868. Nos. 1-12. 1869. Nos. 1-12. 8vo. Berlin.
Sitzungs-Berichte der Gesellschaft Naturforschender Freunde. Berlin. 4to. 1865-69.
Abhandlungen herausgegeben von naturwissenschaftlichen Vereins zu Bremen. Bd. 2, Heft. 2. 8vo. 1870.
Die Vegetationsverhaltnisse Von Croatien. 8vo. Wien, 1868. Von Dr. August Neilreich.
The Transactions of the Entomological Society of London. 1869.
The lifted and subsided Rocks of America, with their influences on the Oceanic, Atmospheric and Land Currents and the Distribution of Races. By Geo. Catlin. London, Trubner & Co. 1870. 12mo.
Grammar of the Choctaw Language. From the MSS., by D. G. Brinton, M. D.
National Legend of the Chata-Muskokee tribes. By D. G. Brinton, M. D.
Contributions to the grammar of the Muskokee Language. By D. G. Brinton, M. D.
The Ancient Phonetic Alphabet of Yucatan. By D. G. Brinton, M. D.
American Scientific Monthly. Vol. 1. No. 1. July, 1870. G. Hinrich, Iowa City, Iowa.
Proceedings of the California Academy of Science. Vol. 1. Part 2. 1870.
Quarterly Journal of Science. London, July, 1870.
American Journal of Conchology. Vol. 6. Part 1. 1870.
Field. July 2d and 9th. London, 1870.
Cosmos. July 2d, 9th and 16th. Liv. 1, 2, 3.
Address on the Natural History and Pathological Osteology of the Horse. By N. Cressy, M. D. Middletown. Jan., 1870.
Bulletin de la Societe Imperiale des Naturalistes de Moscow. Nos. 1, 2, 3. 8vo. Moscow. 1869.
Annales de la Societe Entomologique de France. 8vo. 1869. Paris.
Verhandlungen des naturhistorischen Vereins du preussichen Rheinland und Westphalen. 8vo. 26th Jahrgang. Halft. 1, 2. Bonn. 1869.
Peat Fuel; how to make it, and how to use it. What it costs and what it is worth. T. H. Leavitt. Boston: Lee & Shepard. 12mo. pp. 62. 50 cts.
Le Naturaliste Canadien. Vol. 2. No. 8. July, 1870.
Land and Water. 4, 11, 18 and 25. July.
English Mechanic and Mirror of Science. July 8, 15, 1870. Vol. xi. Nos. 276, 277.
Tiddskrift for Populære Fremstillinger af Naturvidenskaben. Copenhagen. June, 1870.
Bulletin Mensuel de la Societe Imperial Zoologique d' Acclimatation. Tome 7. June, 1870.
Nature. June 30 to July 7, 1870.
The Man who Advertises and American Newspaper Rate Book. Royal 8vo. Rowell & Co. New York, 1870.
Speech of Hon. Geo. F. Hoar on Universal Education.
Revue des Cours Scientifiques de la France et de l'etranger. Paris. Dec. '69 to June '70. 4, 8, 11 of and 2, 9 and 23, July. 1870.
Petites Nouvelles Entomologiques. Nov. 25 and 26.
The North American Lakes, considered as Chronometers of Post Glacial Time. By Dr. Edmund Andrews. Royal 8vo, pp. 23.